Operator's Manual

EASELECTRIC

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Important Safety Instructions

Please be sure to thoroughly read all of the follow safety instructions before using the easel. This will ensure that the easel functions properly and does not pose a risk of injury to any users!!

1) Ensure that the easel is properly assembled as described in the setup instructions on page 24.

2) Make certain that all electrical connections are securely attached, that all bolts and screws are tightened, and that all pins are properly inserted. These parts can be found outlined in the Parts and Accessories section on page 3.

3) Be CERTAIN that the clamp for the tilt actuator is very securely tightened.

4) Keep loose articles of clothing, paper, or any miscellaneous items away from all moving parts.

5) Ensure that the table clamps are securely tightened to the bottom of the table and that they are pinned into place.

6) Ensure that canvas attachment is properly installed and that the canvas or drawing surface is adequately secured.

7) Be certain that the wire connecting the joystick to the easel is not caught on anything that could cause it to be damaged.

8) Check to make sure that all moving parts have adequate clearance that that there are no obstructions preventing their movement.

Parts and Accessories

Here you can find a list of all specific parts of the easel. Their descriptions, names, model numbers (if applicable), purpose, and picture can be found in section referenced to the right of the part. Consult this section for any questions regarding the details of any part of the easel.

1) Left and right table clamps (Section 1.1.1)
2) Left and right table clamp pins (Section 1.1.2)
3) Easel base (Section 1.1.3)
4) Easel base tracking (Section 1.1.4)
5) Floating base (Section 1.1.5)
6) Floating base slides and locking clamp (Section 1.1.6)
7) Easel frame (Section 1.1.7)
8) Easel frame pins (Section 1.1.8)
9) Canvas attachment (Section 1.1.9)
10) Tilt actuator (Section 1.1.10)
11) Tilt actuator attachments and pins (Section 1.1.11)
12) Actuator connection plug (Section 1.1.12)
13) Vertical motion actuator (Section 1.1.13)
14) Vertical motion attachments and pins (Section 1.1.14)
15) Horizontal screw drive (Section 1.1.15)
16) Horizontal tracking and carriage (Section 1.1.16)
17) Horizontal gear motor and enclosure (Section 1.1.17)
18) Horizontal limit switches (left and right) (Section 1.1.18)
19) Limit switch diodes (Section 1.1.19)
20) Electrical enclosure (Section 1.1.20)
21) Relays and description (Section 1.1.21)
22) Relay sockets and description (Section 1.1.22)
23) Power supply and description (Section 1.1.23)
24) Circuit breakers and description (Section 1.1.24)
25) Electrical enclosure cooling fan and description (Section 1.1.25)
26) Easel base joystick port (female) (Section 1.1.26)
27) Joystick attachment wire (Section 1.1.27)
28) Joystick and enclosure (Section 1.1.28)
29) Joystick enclosure port (male) (Section 1.1.29)
30) Master power switch (Section 1.1.30)
31) Joystick power switch (Section 1.1.31)

Features

Congratulations on receiving and good luck on using your new easel! We hope it provides you with the assistance you need to continue you love of art.

This easel has a number of valuable features unlike a typical easel. They are outlined below:

- This easel has the ability to mount to any solid table regardless of its shape provided the table is sturdy enough to support the weight of the easel
- The easel is completely detachable for storage and movement purposes.
- The easel has the ability to move a canvas or drawing surface in six directions: left and right, up and down, tilt towards and tilt away
- The easel is controlled simply by the use of a single joystick
- The easel has the ability to collapse and fold completely flat when not in use
- The easel has a safety switch built into the joystick that can be used to ensure the easel will not move if the joystick is accidentally bumped

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Section 1 - Introduction

Section 1.1 - General Overview of the Device

1. Left and Right Table Clamps

These clamps are used to tightly fasten the easel to the table on which it sits. They are specifically designed to fit around any lips or overhangs that a table might have and are adjustable from a height of 4 to 6 inches. They extend 12" deep and have a large screw which can be tightened thus clamping the easel securely to the table. Make sure these clamps are adequately tightened and appropriately fastened before using the easel!

Figure A

Figure B

2. Left and Right Table Clamp Pins

These pins consist of two threaded eye bolts 3" in total length and two wing nuts. They can be seen in the pictures below. These pins must be inserted though the extensions of the easel base and also through the left and right table clamps. These pins secure the table clamps into place and ensure they can not become detached from the easel. The 5 holes in the table clamps make them adjustable from 4 to 6 inches. The clamps should be aligned appropriately using the least amount of height necessary and then pinned through the corresponding holes (one hole for each table clamp, left and right). The pin should be inserted through the hole and the wing nut should be tightened on the opposite side holding the pin in place and ultimately securing the table clamps. These pins (specifically called "eye bolts") and wing nuts can be easily replaced if lost. They can be found at any hardware store. A pin with a minimum of 2 inches of thread is necessary.

Figure C

Figure D

3. Easel Base

The easel base is the portion of the easel that immediately rests on the surface of the table. This piece is made of 2” square aluminum tubing welded at all corners. Its dimensions are 24” x 24”. The table clamps are designed to securely clamp this component of the easel to the table on which it rests. The extensions off the front of the base are the receptacles for the table clamps and table clamp pins. In the center of this easel base can be found the electrical enclosure. When viewed from the front, the left side of the base contains the plug for the joystick. Resting on the top of this base is aluminum tracking on which the floating base slides sit. The power supply wire extends through the rear of the base.

Figure E

Figure F

4. Easel Base Tracking

This tracking is mounted to the top of the easel base on both the left and right sides. It is manufactured by 80/20 Inc. and can be referenced by part number 1010. This tracking will support the weight of the upper portion of the easel and also allow the easel to traverse horizontally toward the user while the base stays securely fastened to the table.

Figure G

Figure H

5. Floating Base

Resting immediately on top of the easel base tracking is the floating base. It is connected by the floating base slides. This base is the same dimensions as the easel base and allows the upper portion of the easel to move towards and away from the user by utilizing the easel base tracking. It must be adjusted manually. The upper frame of the easel also pins to this portion.

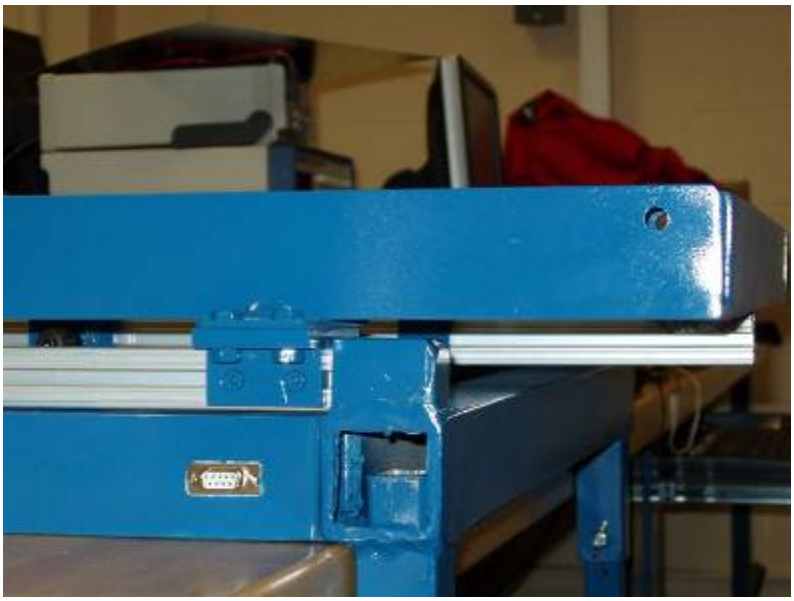

Figure I

6. Floating Base Slides and Locking Clamp

The floating base slides connect the sliding base to the easel base tracking. These slides ride on the easel base tracking and allow the floating base to slide in and out, towards or away from the user. When viewed from the front, the rear left slide has a black handle attached. This is the Locking Clamp. When loosened, the floating base is able to slide freely on the easel base tracking. When tightened, no motion is allowed. The three non-locking slides are manufactured by 80/20 Inc. and can be referenced by part number 6725. The locking slide is part number 6425 and the locking handle is part number 6850.

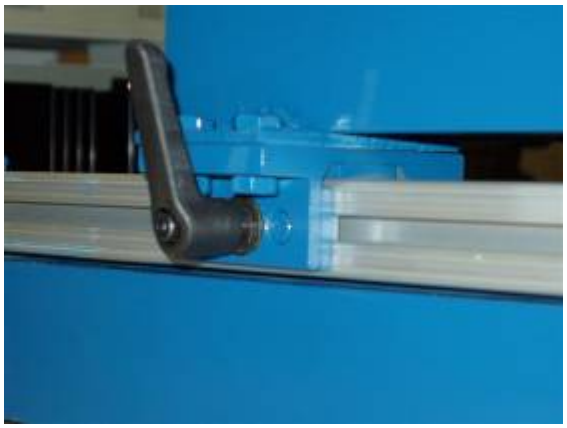

Figure J

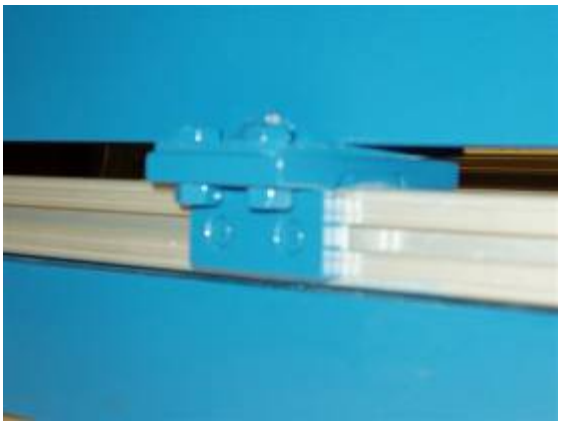

Figure K

7. Easel Frame

The easel frame attaches to the floating base and is 22” high by 22 ½” wide. A number of significant components are attached to this part of the easel including the horizontal screw drive and vertical motion actuator. This part of the easel tilts towards and away from the user and is controlled by the joystick. It is connected as outlined in section 1.2 of this manual.

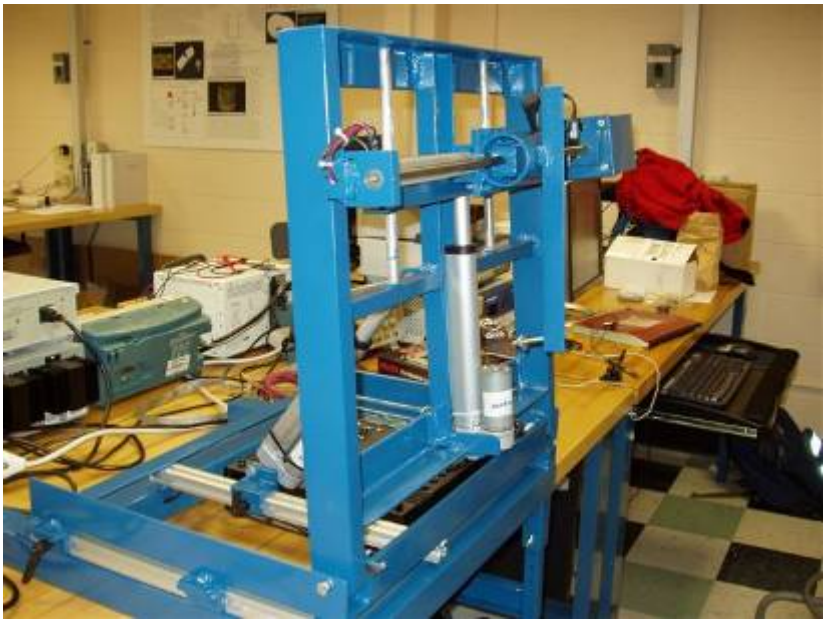

Figure L

8. Easel Frame Pins

These pins are used to secure the easel frame to the floating base. There is one pin each for the left and right sides. Each pin should be passed from the outside of the easel through the holes of the floating base and frame, and secured with a nut on the inside of the easel. A number of washers will provide appropriate spacing and the entire pin assemblies can be seen in the photos below. These pins are replaceable by any hex bolt 4" in total length and ¼" in diameter. Note that the wire exiting the right side of the easel frame should wrap AROUND the bolt on the right side of the easel. This is detailed in the section regarding the actuator connection plug.

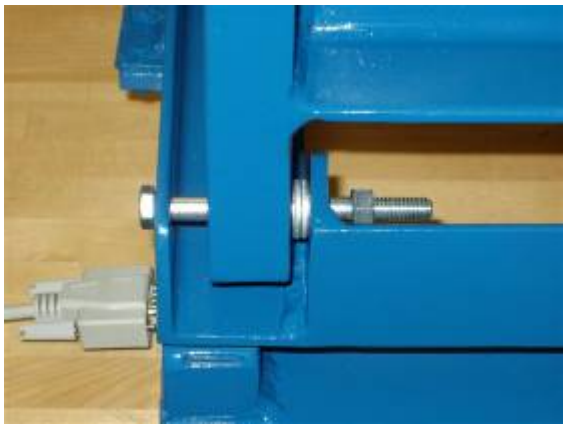

Figure M

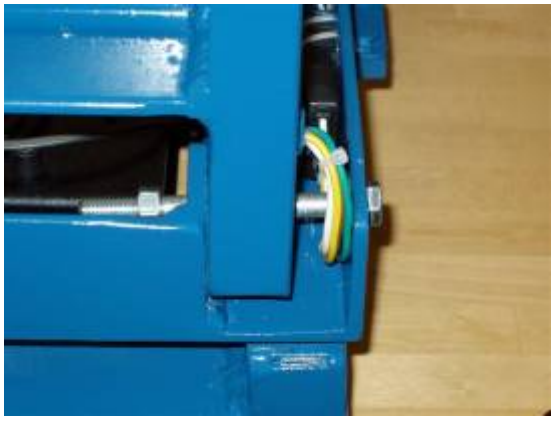

Figure N

9. Canvas Attachment

The canvas attachment is the triangular piece mounted to the front of the easel. It is

adjustable in its vertical position by loosing the locking handle (80/20 Inc. part number 6850) located behind the canvas attachment just above the horizontal screw drive. A canvas or drawing surface should be placed on the ledge of the canvas attachment and the locking clamp on the front of the attachment should be adjusted to securely fasten the drawing surface.

Figure O

Figure P

10. Tilt Actuator

The tilt actuator allows the easel to be automatically tilted towards or away from the user. It is located directly behind the easel frame and attaches to both the frame and the sliding base. The actuator is manufactured by a company called Firgelli Automations. It is rated for 165lbs and can be referenced by model number ZYCJ(s)07-8-12-6".

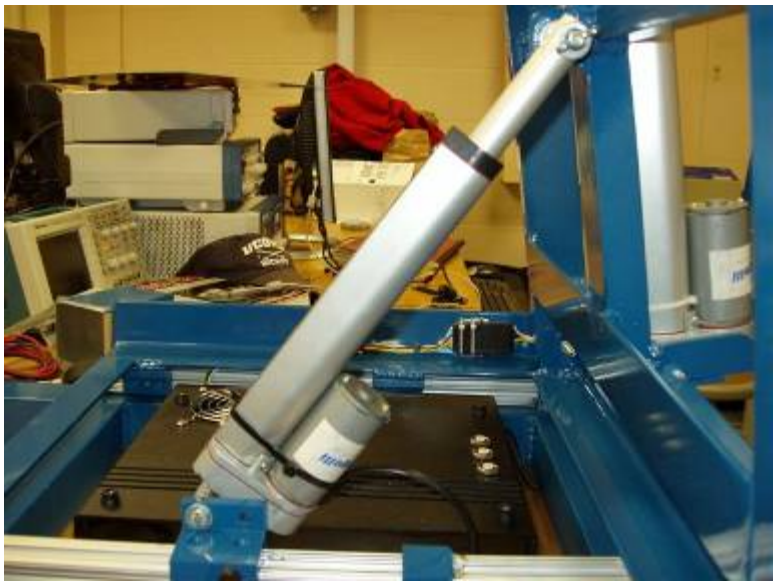

Figure Q

11. Tilt Actuator Attachments and Pins

The tilt actuator is secured to the easel at two points. The top of the actuator attaches to the back of the easel frame via an eye bolt and wing nut and is assembled as shown in the following pictures. The bottom of the actuator attaches to a linear slide with a locking clamp (80/20 Inc. part numbers 6415 and 6850) that is welded to the floating base. BE CERTAIN THAT THIS CLAMP IS SECURELY TIGHTENED PRIOR TO ANY USE OF THE EASEL. This clamp slides along a piece of linear tracking and allows the positioning of the actuator to be adjusted. Changing this position will ultimately control the degree to which the easel can tilt toward the user. The actuator is attached to this slide with a 2" hex bolt, washers, and spacer as shown in the photo below.

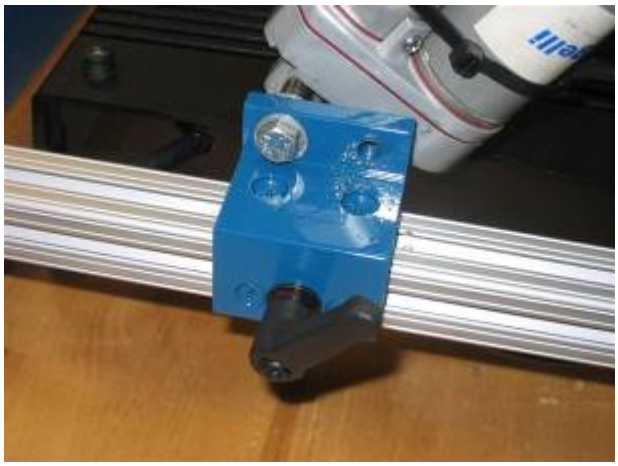

Figure R

Figure S

12. Actuator Connection Plug

The actuator connection plug provides power to the vertical motion actuator and horizontal screw drive motor. One end of the plug is located on the wire extending from the bottom right corner of the easel frame. The other end is mounted to the right side of the horizontal base. The wire exiting the easel frame should WRAP AROUND the easel frame pin and plug securely into the receptacle mounted on the floating base. Connect the plug as shown in the following photos.

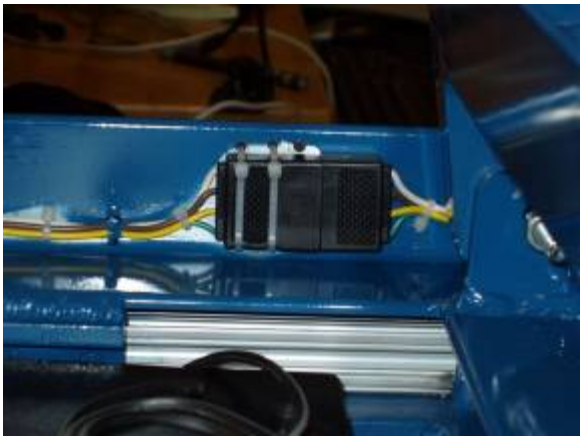

Figure T

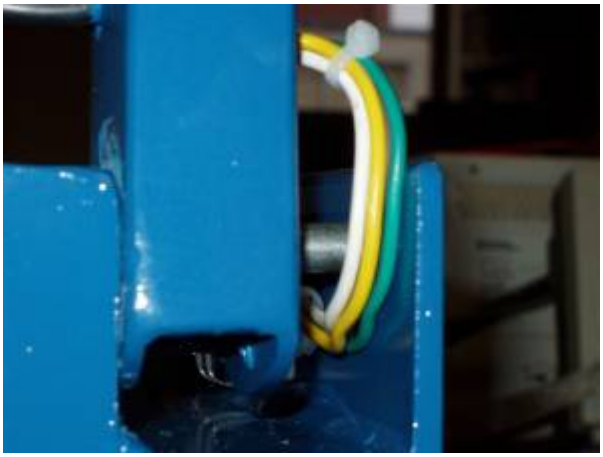

Figure U

13. Vertical Motion Actuator

The vertical motion actuator is mounted inside the easel frame. The bottom is inserted though a hole in the bottom of the frame and secured with a retaining clip. The top is bolted to the bar that controls the vertical motion. This actuator is the same type as the tilt actuator. It should not need to be removed although can be easily done by removing the upper bolt and lower retaining clip.

Figure U

14. Vertical Motion Attachments and Pins

The vertical motion attachments consist of the actuator mounting bolts and retaining clip as well as the traveling rail. The mounting bolt attaches the top of the actuator to the traveling

rail. The retaining clip secures the bottom of the actuator through a hole in the easel frame. The traveling rail rides on two vertically mounted cylindrical rods. These rods support the horizontal screw drive and allow the easel to travel vertically up and down.

Figure V

Figure W

15. Horizontal Screw Drive

The horizontal screw drive controls the horizontal motion of the easel. This screw drive is a steep threaded rod that is mounted above the horizontal tracking. It extends through a pillow block bearing on both ends which allow it to rotate and also runs through the center of the horizontal carriage. The right side of the screw drive is coupled to the horizontal gear motor.

Figure X

Figure Y

16. Horizontal Tracking and Carriage

The horizontal tracking is a piece of 80/20 Inc. extrusion (Part number 1010) that is fastened to the vertical traveling rail. On this tracking rides the horizontal carriage which connects the canvas attachment. The carriage is 80/20 Inc. part number 6726. Mounted to the top of this carriage is a bracket which contains a threaded insert. This insert rides on the horizontal screw drive and is ultimately responsible for moving the carriage along the tracking.

Figure Z

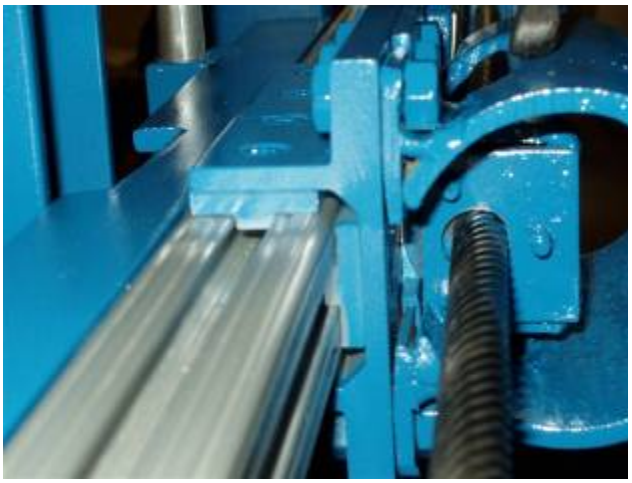

Figure AA

17. Horizontal Gear Motor and Enclosure

The gear motor is mounted to the right side of the easel frame. It is coupled to the horizontal screw drive and is responsible for the horizontal movement of the easel. The motor runs on 12 volts DC and draws 1.3 amps at full load. It can provide 40 in-lbs of torque and rotates at 12 revolutions per minute. The motor itself is enclosed in an aluminum box mounted on the right side of the easel frame. It should not be necessary to access the motor inside this box.

Figure AB

Figure AC

18. Horizontal Limit Switches

The limit switches are mounted at the left and right ends of the horizontal screw drive. They function to stop the carriage from traveling beyond their maximum possible distance. These switches are each wired with a diode which allows the motor to be reversed while the switch is activated. See section 3.2 Electrical System for more detailed information.

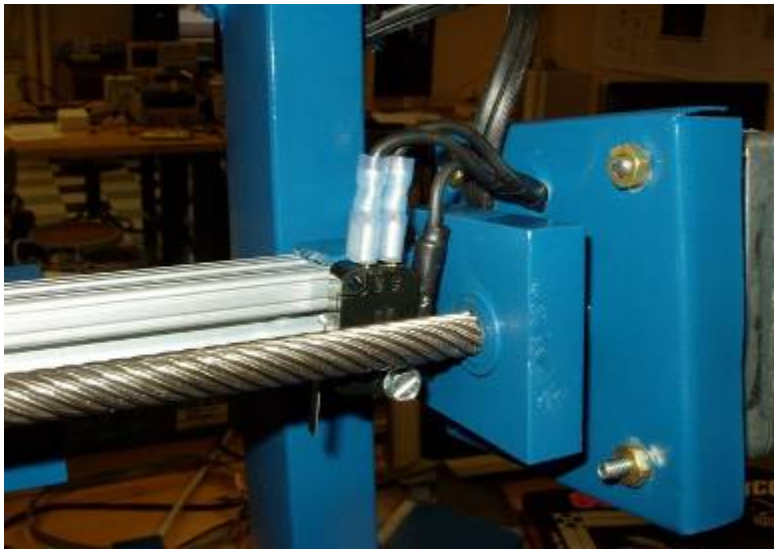

Figure AD

19. Limit Switch Diodes

The limit switch diodes can be referenced by the generic part number 1N1202RA+JAN. These diodes have a peak reverse voltage of 200 volts and a maximum output current of 12 amperes. They work to allow current flow in only one direction thus allowing the horizontal motion motor to be reversed once the limit switch has been reached. See the Electrical System section (3.2) for detailed information on their use.

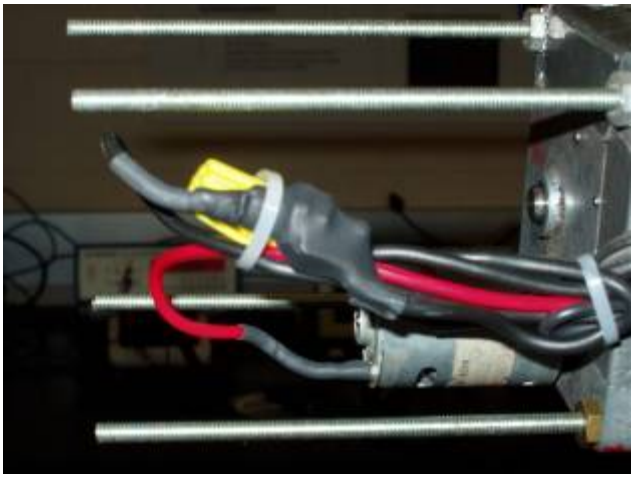

Figure AE

20. Electrical Enclosure

All electrical components, including the power supply, relays, cooling fan, and circuit breakers, are all housed in the electrical enclosure. The enclosure is manufactured by Teko Enclosures and can be referenced by part number 862.9. It is secured in the center of the easel base and all wiring throughout the easel runs into this enclosure. Use extreme caution not to damage this enclosure or spill anything into it. A master on/off switch is located on the left side of the box. Three 2-amp circuit breakers are located on the top of the box. The cooling fan can also be seen in the top of the box.

Figure AF

21. Relays and Description

The relays used in this easel are manufactured by Potter and Brumfield. They are double-pole/double-throw and rated for 12 volts DC at 15 amps. Their part number is K10P-11D15-12. Each actuator or motor in the easel has two relays associated with it. The relays allow a small current from the joystick to activate the much larger current drawing actuators and motor. There is one relay for each direction of each motor/actuator. See the Electrical System section (3.2) for more detailed information.

Figure AG

22. Relays Sockets and Description

Each relay plugs into a socket to which all wires are attached. This allows the relay to be easily replaced should it malfunction. The sockets are manufactured by Potter and Brumfield and can be referenced by part number 27E895. They are designed to snap onto a metal rail which is first mounted into position. This rail, called DIN Rail, is mounted to the bottom of the electrical

enclosure.

Figure AH

23. Power Supply and Description

The power supply for the easel is one of the most important components. It is mounted in the electrical enclosure. It is manufactured by Mean Well Enterprises Co, Ltd. (Part number RS-150-12) It uses 120 volts AC and outputs 12 volts DC at 150 watts (roughly 12 amps). This power supply powers all electrical aspects of the easel. It can be turned off through the master on/off switch located on the side of the electrical enclosure.

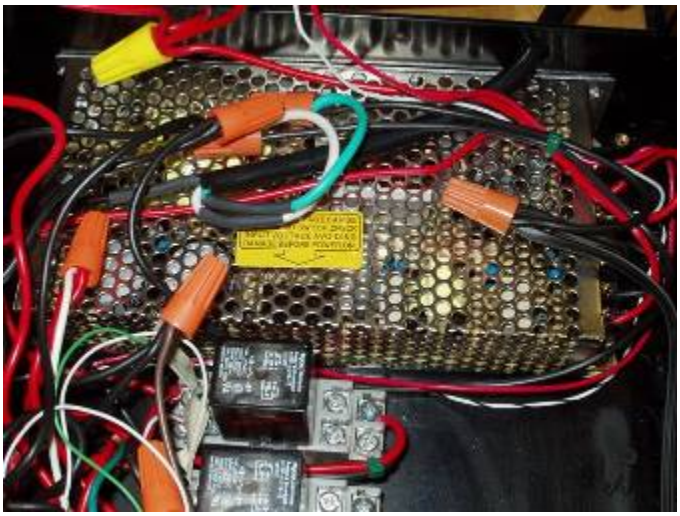

Figure AI

24. Circuit Breakers and Description

The circuit breakers can be seen in the top of the electrical enclosure. There is one breaker for each actuator/motor in the easel. They are provided as a safety feature and will fault

if any motor/actuator draws more than two amps of current. The maximum current rating for the actuators is just over 2 amps, so these breakers are designed to fault just short of maximal force exerted by the actuators. Should a breaker fault, the white center piece will protrude out of the breaker. To reset, first turn off power to the easel, push the white piece back into position, then restore power. If the breaker faults again there is a problem with the electrical system. Please seek knowledgeable help prior to attempting any electrical repairs.

Figure AJ

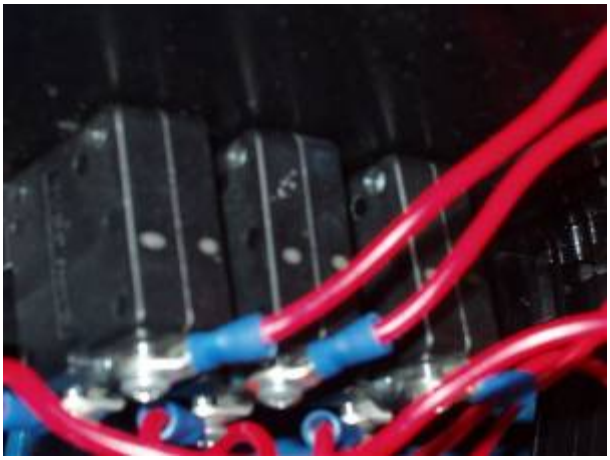

Figure AK

25. Electrical Enclosure Cooling Fan and Description

The cooling fan can be seen in the top of the electrical enclosure. This fan simply circulates air through the electrical enclosure to prevent any of the components from overheating. It can be replaced with any 12 volt DC 80mm diameter fan. Excessive heat should not be a concern with this easel, however if you do notice a significant amount of heat being expelled from the enclosure there may be a problem. Seek knowledgeable help prior to attempting any electrical work.

Figure AL

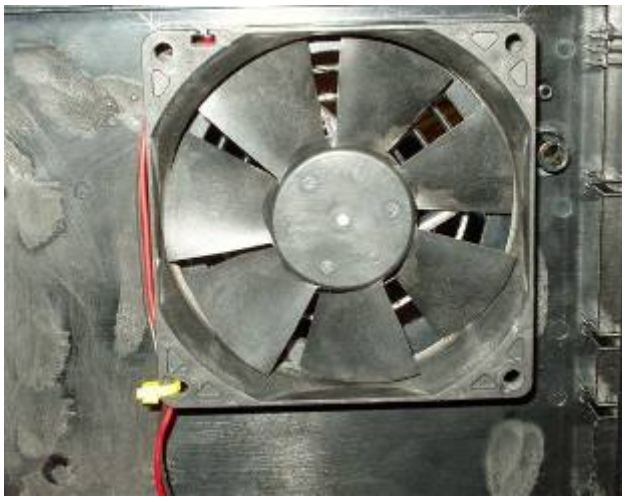

Figure AM

26. Easel Base Joystick Port

On the left front side of the easel base can be found a small plug. This is where the cable from the joystick is attached. Firmly push the wire into the plug. Be careful not to exert excessive force on this plug! Make sure the attached wire is rested and clear of obstructions.

Figure AN

27. Joystick Attachment Wire

The wire which attaches the joystick to the easel is a simple serial cable which can be purchased at any electronic or computer store. It consists of 9 individual pins/wires and is often used for attaching computer peripherals. Ensure that both ends of the cable are securely attached before using the easel. Be careful not to exert excessive force on this wire.

Figure AO

28. Joystick and Enclosure

The joystick is manufactured by P-Q Controls and can be referenced by model number M215-28SW-S-66. It is made of 4 microswitches and a thumb rocker switch. This allows for three motors to be controlled: up/down, left/right, tilt toward/tilt away. The joystick enclosure is manufactured by Teko Enclosures (part number 383.18). A port is located in the side of the joystick enclosure for the joystick wire.

Figure AP

29. Joystick Enclosure Port

The port located on the side of the joystick enclosure is designed to accept one end of the serial cable that connects the joystick to the easel. Firmly insert the plug on the wire into the port on the side of the joystick enclosure. Screw the thumb screws in to the port to secure the cable into place. Be careful not to put excessive force on the wire while plugged into this port as it could damage the port.

Figure AQ

30. Master Power Switch

The master power switch is located on the forward left side of the electrical enclosure. It is a small black rocker switch that controls the power to the easel. When this switch is off, all power to the electrical system, including the power supply, is interrupted. None of the relays, motors, actuators, or the joystick will function.

Figure AR

31. Joystick Power Switch

On the joystick enclosure is an illuminated rocker switch. This switch is used to disable the joystick. When activated, this switch will illuminate red and the joystick will be able to control the movement of the easel. When turned off, this switch will no longer illuminate and the joystick will not be able to control the easel. This can be used to prevent accidental

movement of the easel if the joystick is moved when not desired. If this switch it turned on and does not illuminate nor does the joystick control the easel, ensure that the joystick cable is attached at both ends and secured and that the master power switch is turned on.

Figure AS

Assembly

*Please note, the Easelectric is a heavy duty device capable of lifting large canvas weights and sizes. Be sure to use a steady table capable of supporting a 60 lb load. This set up is better preformed with the assistance of one other person.

1. Position the device on a flat table surface. Make sure the overhanging collars off the front of the easel's base are pushed all the way against the table.

Figure AT

2. Slide the clamping arms up into the collars with the "open" portion of the channel facing inward (Figure AU). These are adjustable to fit a variety of table dimensions, including

room to attach around any lips or extrusions hanging off the table. Set the arms in with the pins (Figure AV) and hand-tighten the clamps for a nice snug fit.

Figure AU

Figure AV

3. Attach the top assembly by setting bolts through the rectangular tubing frame as seen below. Be sure to include the correct amount of washers and wrench-tighten the bolts. Tilt the entire top frame forward to connect the plugs on the right hand side of the frame (Figure AY). (This step will need two people to help hold the weight of the top frame.)

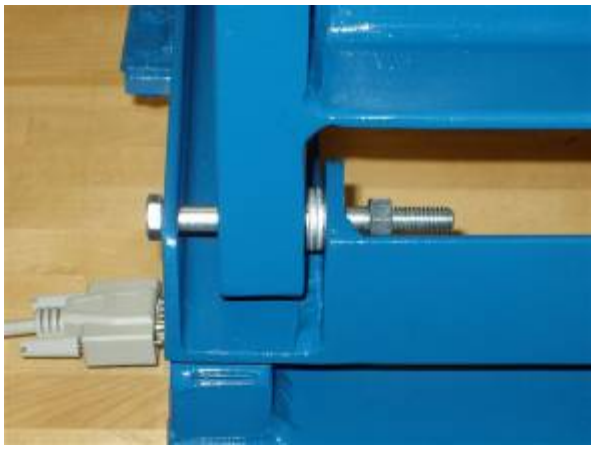

Figure AW: Left Frame Pin

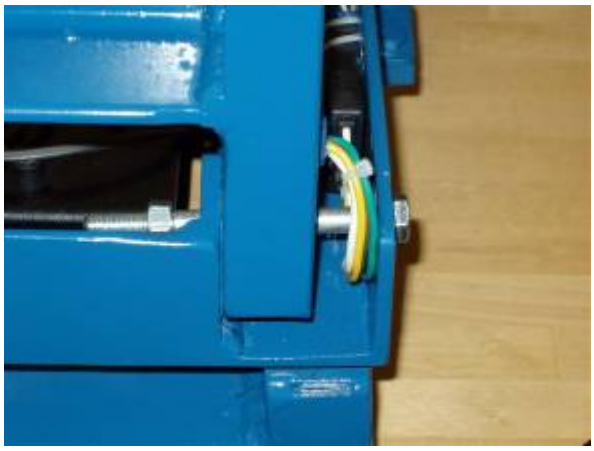

Figure AX: Right Frame Pin

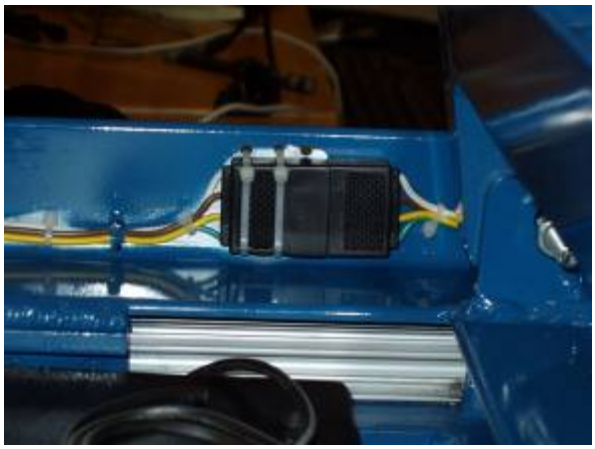

Figure AY

4. Next, pull the frame tilting from the rectangular tubing pieces forward, and connect the tilting actuator to the small back plate (Figure AZ) using the bolt assembly seen below. The correct order of the hardware starting from the bracket on the easel frame is: I-bolt through bracket, washer, spacer, washer, actuator, washer, wing nut (Figure BA). (Be sure to clamp the slider holding the actuator snug to the track before beginning the attachment.)

Figure AZ

Figure BA

5. Once desired tilt adjustment location is identified, insert safety pin into the 80/20 extrusion in front of where the tilt actuator is located. This will prevent the easel face from falling forward into the face of the user should the brake on the tilt adjustment bracket fail.

Figure BB

6. Slide the easel face on the mounts shown in the figure below (Figure BC). These brackets were made to allow for a manually adjustable vertical range. Set the easel face in the lowest position possible for the artist (Figure BD). (There is a risk of injury if this step is not carefully set correctly due to the force of the easel making contact with the artist or other objects when moving downward electrically.) From the lowest position, the easel can safely move vertically upwards and never move down further than this set point.

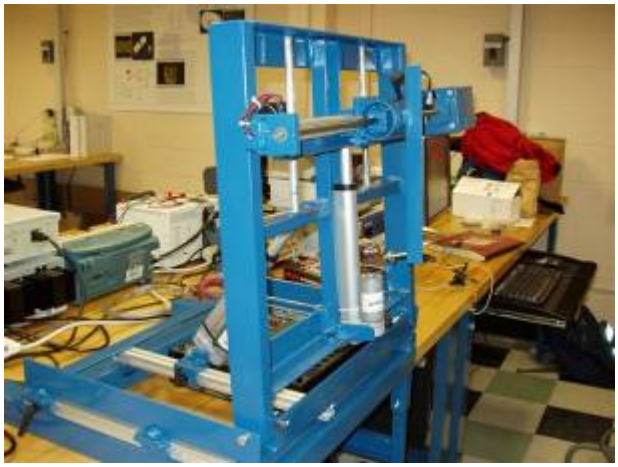

Figure BC

Figure BD

7. Set the canvas on the easel face and adjust the front clamp to snugly attach the canvas to the easel face.

8. Connect the serial cable to the ports located on the joystick and left side of the easel's base. The joystick box can be strapped to a small arm rest or strapped around the artist's leg if necessary using the Velcro straps.

Figure BE

9. Plug in the power cord to a wall outlet or power strip. You are now ready to begin using the easel.

Figure BF

Section 1.2 – Proper Use of the Device

The Easelectric was built to accommodate for all different types of positions, table dimensions, and ranges of motion. The tilting, vertical, and forward and back motions are all manually adjustable to accommodate for differing ranges.

Turning On/Using the Easel

1. The artist should position him/herself at a comfortable distance from the device.

2. The supervisor can pull the carriage of the easel out, closer to the artist if necessary (Figure 1.2.1). Be sure to clamp the back left slider firmly to avoid unwanted movements while painting (Figure 1.2.2).

Figure 1.2.1: Note, the easel frame and face *are not* attached.

Figure 1.2.2

3. Turn the power on to the device by pushing the black switch on the black box housing the circuitry to the “on” position.

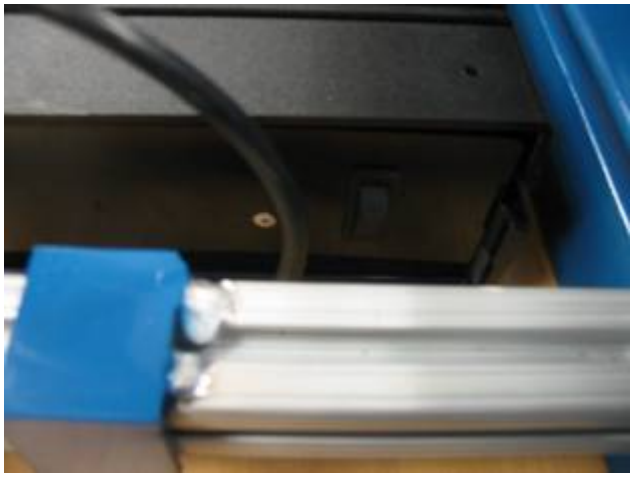

Figure 1.2.3

4. The artist can then enable the joystick by pushing the small button on the side of the box to “on” position. (The switch will light up when the joystick is functional.)

Figure 1.2.4

5. Move the canvas using the following configuration for the joystick:

Joystick Movement	**Canvas Movement**
Forward	Up
Back	Down
Right	Right
Left	Left
Tilt Fwd.	Tilt Away
Tilt Bkwd.	Tilt Toward

6. Turn the power to the joystick off before painting to avoid unwanted movements caused by accidental forces against the joystick by using the red rocker switch.

Figure 1.2.5

7. Paint.

Figure 1.2.6

8. To increase the range of vertical motion, simply set the easel in the furthest down position electrically, and manually adjust the easel face along the mountings as seen in the set-up step 6.

9. To increase the range of tilting motion, unclamp the middle slider and push or pull the main vertical frame to the desired position. Be sure to tighten the clamp firmly and re-insert the safety pin after establishing this range.

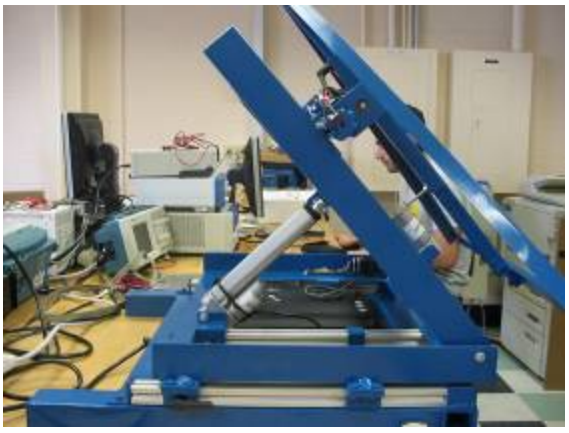

Figure 1.2.7: Minimum Tilt Angle

Figure 1.2.8: Maximum Tilt Angle

Turning Off/ Putting the Easel Away

1. To turn off the easel, be sure to return each of the moving parts to its most compact position before disassembling. **This means bringing the easel all the way down and tilted all the way back.**

Figure 1.2.9

2. Turn off power to the joystick BEFORE turning power off to the main power supply located on the black box within the easel's base.

Figure 1.2.10

3. Slide the easel face up to the highest position (Figure 1.2.9).

4. Unclamp the slider on the left side of the base and push the upper frame all the way back until the slider fits against the aluminum stoppers.

5. Move the slider connected to the base of the actuator to the furthest, back position (Figure 1.2.11). Detach the tilting actuator from the top of the vertical columns and lay the actuator down next to the black circuit box (Figure 1.2.12).

Figure 1.2.11

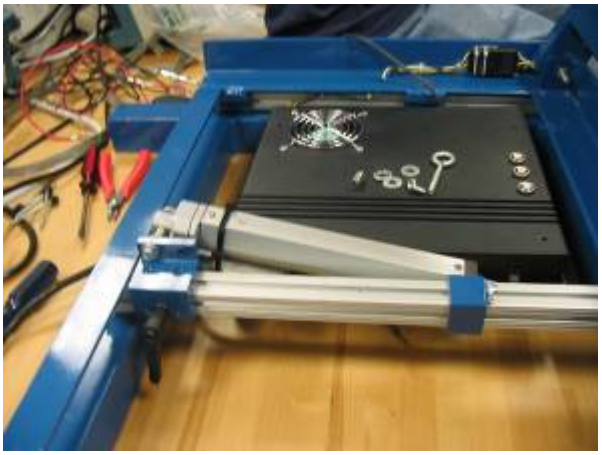

Figure 1.2.12

6. Carefully lay the top of the easel frame down along the base. Attach the safety chain to avoid the easel from opening when in storage or in transportation.

7. Loosen the table clamps, remove the eyebolt and wing nut assemblies, and pull the clamping arms out of the easel base.

Figure 1.2.13

8. Remove the device from the table and store it away in a convenient location. Be sure to wind up the power cord and be careful not to snag the wiring on other objects or people.

Section 2 - Maintenance

Section 2.1 – Mechanical Maintenance

I. Easel Base

Occasionally the rubber feet on the top of the clamps may need replacing. To do this, first insure that the easel is safely sitting on the table top and that the easel face is tilted away from the user (Figure 2.1.1.1). Having completed this, loosen the threaded rod (Figure 2.1.2) by turning the handle counter-clockwise until the rubber foot is free from the table.

Figure 2.1.1

Figure 2.1.2

Next, loosen the wing nut of the I-bolt that is pinning the clamp in place (Figure 2.1.3) and remove the bolt from the hole. Remove the clamp from the square tubing. With the clamp separated from the base, remove the rubber footing by pulling it off the end of the rod (Figure 2.1.4). Replacement feet can be conveniently found at any hardware store.

Figure 2.1.3

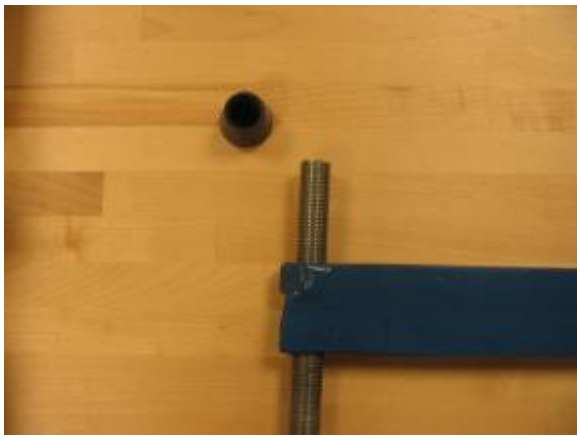

Figure 2.1.4

The 80/20 aluminum tracking (Figure 2.1.5) will need to be periodically cleaned of debris such as the high density polyethylene that may wear off of the bearings, paint chips, and dust.

There are two options for removing the debris from the track. First you can use compressed air, either from a compressor or from a can of compressed air. Using the compressed air, blow any debris free from the tracks (Figure 2.1.6). Another option for cleaning out the tracks would be to use rubbing alcohol and a cotton swab. Insert the end of the cotton swab that is wetted with the rubbing alcohol into the groove in the track and remove the debris.

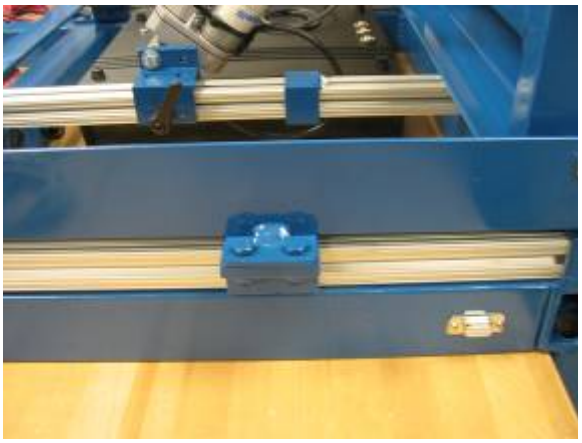

Figure 2.1.5

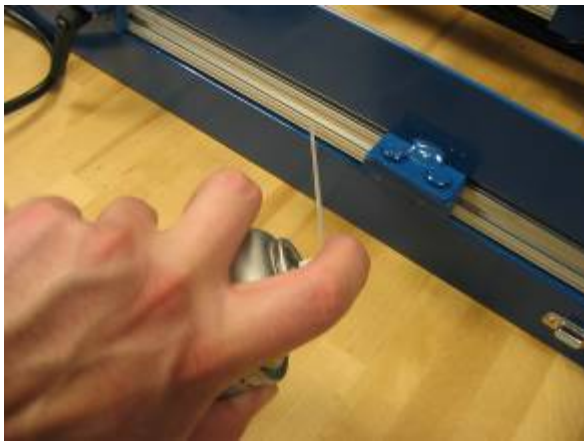

Figure 2.1.6

II. Floating Base

The four linear bearings (Figure 2.1.7) that slide on the 80/20 track on the easel base will wear down over time with use and may cause the floating base to become loose. To alleviate this problem, loosen the two Phillips head screws that hold the polyethylene bearings to the aluminum enclosures (Figure 2.1.8). Place the screw driver in front of the polyethylene bearing and in the slot in the tracking and push back to dislodge the bearing from the aluminum enclosure (Figure 2.1.9).

Figure 2.1.7

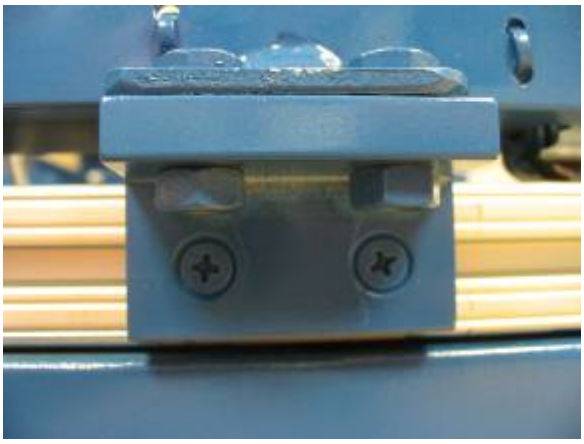

Figure 2.1.8

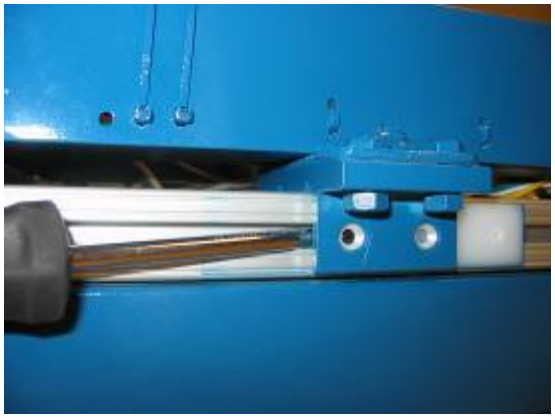

Figure 2.1.9

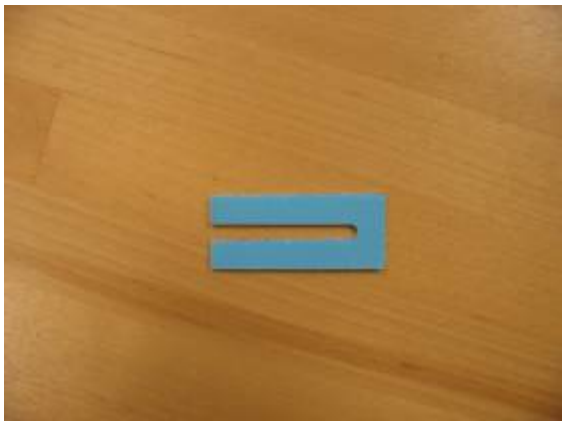

Figure 2.1.10

Peel off one of the included blue shims (Figure 2.1.10) from the stack and place it on the outside of the polyethylene bearing with the open end facing towards the aluminum slide assembly (Figure 2.1.11). Slide the polyethylene bearing and shim back together into place and replace the screws. Should the wear become so severe that the shims become unsafe to use, the polyethylene bearing will need to be replaced. These can be ordered from 80/20's distributor Air Incorporated (http://www.airincorporated.com/) and are Part #6705 (10 Series White UniBearing Pad) (Figure 2.1.12).

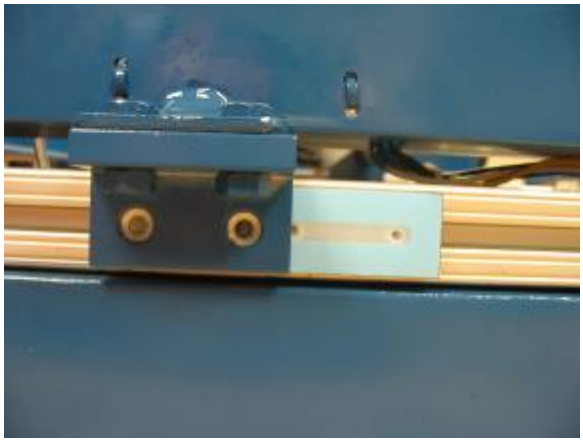

Figure 2.1.11

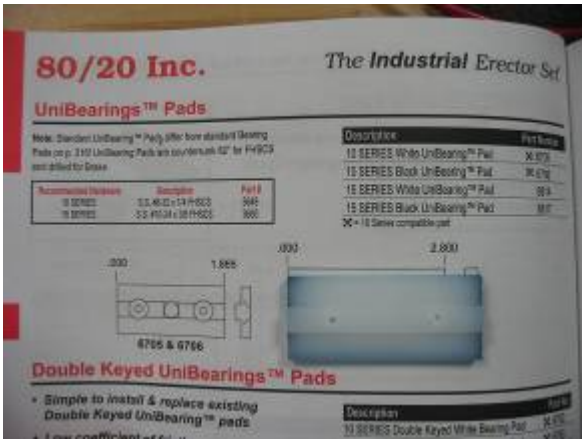

Figure 2.1.12

III. Easel Frame

The component of the easel frame which requires the most care is the screw drive assembly (Figure 2.1.13). In order for it to correctly function, the drive must be properly lubricated using bearing grease or a similar product (Figure 2.1.14).

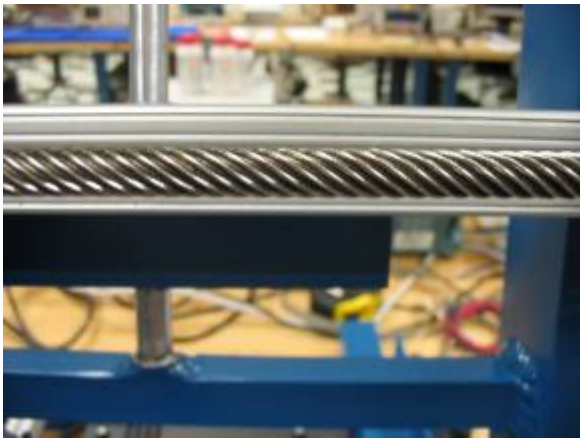

Figure 2.1.13

Figure 2.1.14

If the threaded rod feels rather dry to the touch, then it must be lubricated. Start by inserting your finger into the grease and getting a small amount on your finger tip (Figure 2.1.15). Work a small amount of the grease onto the rod near the circular opening on the carriage (Figure 2.1.16). Once the grease is on the rod, move the carriage back and forth on the rod, distributing the grease throughout the track. Repeat this process several times until you can see the grease lightly coat the track (Figure 2.1.17). Use special care when handling the grease. Wash your hands thoroughly with soap and water after use and be sure not to touch your eyes or mouth until you have done so.

Figure 2.1.15

Figure 2.1.16

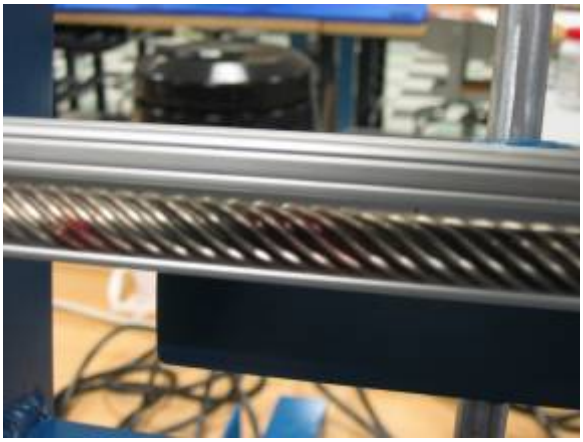

Figure 2.1.17

Figure 2.1.18

Should the vertical motion component stick on the round vertical rods paralleling the vertical linear actuator (Figure 2.1.18), they too should be greased lightly with a very thin coat of bearing grease or with 3-in-1 oil.

As with the floating base portion of the easel, the polyethylene bearings need to be checked and adjusted for wear after long periods of use. Follow the steps given in the floating base section to address this problem.

If the linear actuators or gear motor powering the screw drive start to "hiccup" or move erratically, they will most likely need to be lubricated as well. Performing this process involves disassembling the outer cover of the actuators and motor to gain access to the gears contained within the devices. It is recommended that should this need to be performed, knowledgeable assistance should be sought to avoid damaging these components.

IV. Canvas Attachment

The canvas attachment portion of the easel (Figure 2.1.19) requires very little mechanical maintenance. Should a plastic brake handle (Figure 2.1.20) break or the threads become damaged, a replacement part can be ordered from 80/20's Distributor, Air Incorporated (http://www.airincorporated.com). Ask for part #6850.

Figure 2.1.19

Figure 2.1.20

Section 2.2 - Electrical Maintenance

Refer to this section for information regarding general maintenance for the electrical system of your easel. You can also find information on changing or repairing certain aspects of the easel.

I. Power Cord

The power cord attached to the back of the easel provides the main electrical supply to the easel. Ensure that this cord is not knotted (other than the two locking knots where the cord exits the easel base). Also keep the cord away from hot surfaces such as heaters and stoves as this could cause the cord to melt and become hazardous. Do not place the cord under heavy objects or anything that could crush the cord. Lastly, no excessive force should be applied to the cord. Do not pull on the cord or place it in such a way has to become a tripping hazard.

Routinely check the cord to ensure that there are no cracks or cuts in the outer insulation. Small cracks or cuts can be wrapped with a suitable material such as electrical tape to prevent further damage. However if any cracks or cuts exist that reveal bare wire, then the power cord needs to be replaced. This will require some electrical work and is not recommended without knowledgeable help. To replace the cord, the electrical enclosure must be opened. Instructions for this can be found in the Electrical Enclosure description is this maintenance section. Do NOT open the enclosure before unplugging the power cord. Trace the cord into the power supply and follow the three individual wires that are enclosed within the outer insulation. The three wires (green, white, and black) will need to all be disconnected. Obtain an appropriate replacement cord (120 volt AC grounded) and wire the new cord exactly as the original one was wired. The neutral leg (white) and ground (green) are attached directly to the power supply. The powered leg (black) is run into the master rocker switch. Be sure to retie the stopper knots in the cord similar to the existing one to prevent the cord from pulling out of the easel should it be pulled.

Figure 2.2.1

II. Electrical Enclosure

The electrical enclosure houses the most important and fragile components of the easel. Take extreme care to ensure that this enclosure is not damaged. Do not place items on top of the enclosure. Keep all liquids away or anything else that could fall inside. Make sure the enclosure is adequately vented and the fan mounted in the top is free of obstructions. All wires that control the easel enter this enclosure so it is vital that it is taken care of. Do NOT open the enclosure while the easel is plugged in or turned on as you will be exposed to bare electrical connections.

There should be minimal need to open the enclosure, however if it must be opened, unplug the easel first. Using a screwdriver, remove the four screws on the top of the enclosure holding it together. Once the screws are removed, the top can be opened. Use care when opening the enclosure as there are wires attached to the top. Inside the enclosure are the power supply, relays and sockets, as well as the cooling fan and circuit breakers attached to the top.

NOTE: The enclosure can be difficult to close once it is opened. Use care to ensure that no wires are caught in the edge or sitting on top of the relays when closing. The same process for opening is reversed to close the enclosure.

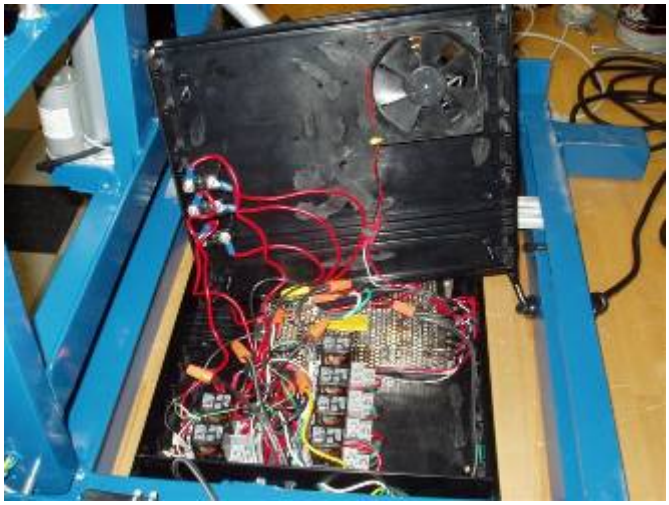

Figure 2.2.2

III. Relays

The relays in the electrical enclosure control the movement of the easel. When the joystick is activated in any direction, it triggers a relay which in turn provides power to the appropriate motor or actuator. Each motor/actuator has two relays assigned to it: one for forward motion, one for reverse. The relays require no maintenance as they are protected inside the electrical enclosure. If, in the rare circumstance that a relay fails to function properly, it can be replaced by the following procedure. Unplug the easel and refer to the instruction regarding opening the electrical enclosure. You will see the six relays plugged into their respective sockets. While holding down the socket, CAREFULLY rock the relay back and forth while pulling upwards to unplug the relay from the socket. New relays can be

purchased from any electronic company. See the relay specifications in section 1.1.

Relay sockets are not easily replaced. They require being completely unwired and removed from their attachment rail. Neighboring relays may also be dependent on the wiring of a single relay socket. The need to replace a socket should be an extremely rare occurrence.

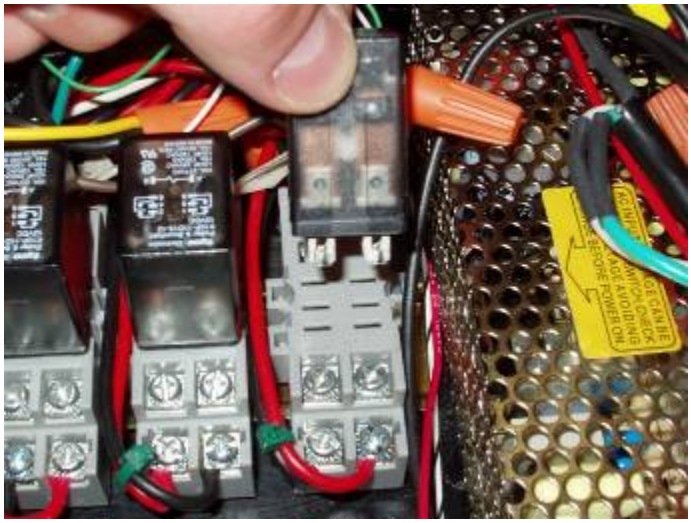

Figure 2.2.3

IV. Circuit Breakers

The circuit breakers are mounted in the top of the electrical enclosure and hang down into the enclosure. There is one breaker for each of the two actuators and for the horizontal drive motor. These breakers are rated to fault at any current draw over two amperes. The maximum currents for any of the motors should never exceed two amps. If for some reason, a motor failed and drew an excessive amount of current, or a wire came loose and shorted, one of the circuit breakers corresponding to that motor will fault. This will stop any electrical flow through that circuit preventing damage to the easel or harm to the user.

Keep the breakers free of obstructions and do not place anything on top of them as their ability to fault relies on them being able to extend. Before using the easel, ensure that the white portion of each breaker on the top of the electrical enclosure is flush with the enclosure. It will be clearly evident if the breaker has faulted, as the white part will extend upwards roughly ½". To reset the breaker, simply turn off the easel and press the extended white piece back into the breaker. If the breaker faults again after turning the power back on, a serious electrical issue may be the problem. Discontinue use of the easel and seek knowledgeable help in diagnosing/repairing the problem.

V. Electrical Enclosure Cooling Fan

The cooling fan simply maintains air flow throughout the electrical enclosure and helps to keep any electrical parts from overheating. Keep any obstructions away from the fan and do not place anything into the fan. Whenever the master power switch is turned on, the cooling fan should be running. If it is not, ensure the easel is plugged in. If the easel

functions as normal yet the fan continues to sit idle it may need to be replaced. This can be done by opening the electrical enclosure (see instructions in part II). The four screws on top of the enclosure holding the fan grill and fan together will need to be removed. This will then free the fan. It will also need to be disconnected from the power supply. Make sure the easel is unplugged before attempting any repairs. A replacement fan can be easily purchased from any electronic or computer supplier. It needs to be rated for 12 volts DC and be 80mm in size.

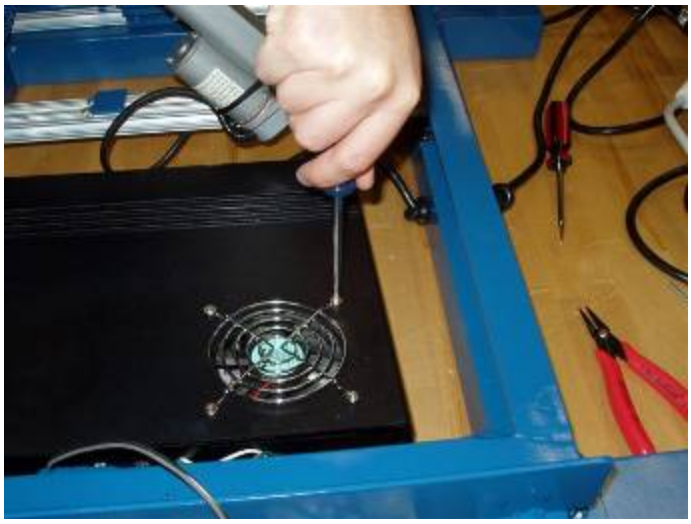

Figure 2.2.4

VI. Actuator Connection Plug

This plug provides power to the vertical motion actuator and horizontal motion motor. There should not need to be disconnected unless the easel is being disassembled. If the plug is disconnected, be sure that nothing as accidentally gotten into any of the individual sockets (i.e. lint, dirt, liquids). Under normal use simply check to ensure that none of the wires of the plug, or the plug itself are damaged. This plug is not replaceable so be sure that it does not get damaged under normal use or when collapsing the easel frame.

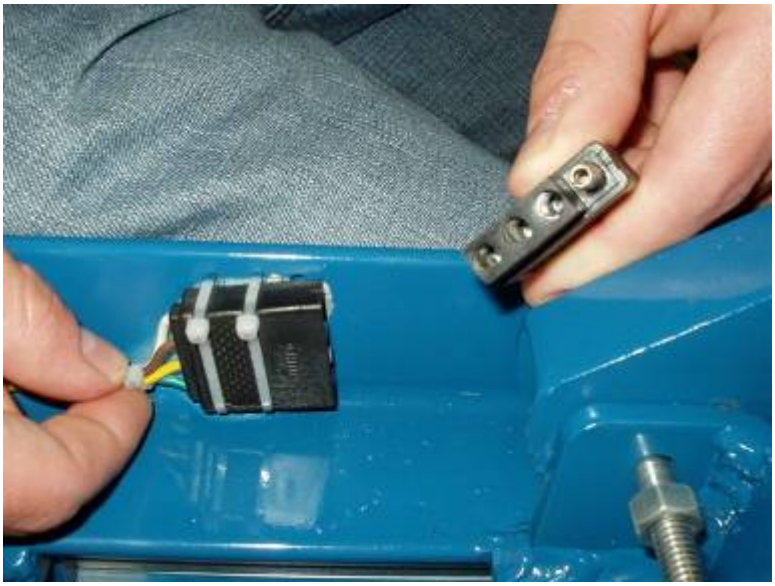

Figure 2.2.5

VII. Actuators

The two actuators on the easel are responsible for the vertical and tilt motions. There is limited maintenance that they require other than ensuring that they are not overly stressed by excessive weight and that they have a free range of motion when moving. They are self contained and hard wired into the electrical system. In the event that an actuator fails, it can be replaced by contacting Firgelli Automations and obtaining a 6" actuator of model number ZYCJ(s)07-8-6". The wire will need to be cut and the new actuator will need to be wired into the electrical system.

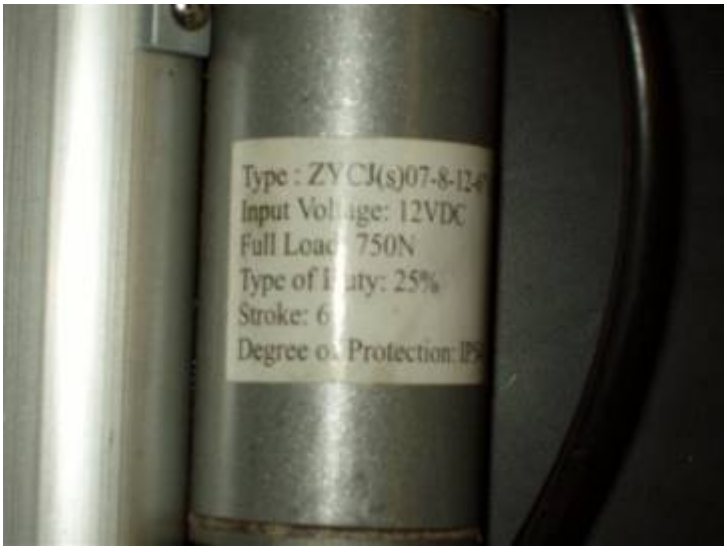

Figure 2.2.6

VIII. Horizontal Gear Motor

This motor controls the horizontal motion of the easel. There is no electrical maintenance required other than keeping all wires free of obstruction. The motor is enclosed in an aluminum box to keep it protected. It is connected the same as the actuators. All power wires for the motor run through the frame of the easel itself.

IX. Limit Switches and Diodes

The limit switches are mounted at both ends of the horizontal tracking. These limit switches serve to ensure that the horizontal traveling carriage will not travel beyond the distance of the limit switch as this could cause damage to the carriage, tracking, screw drive, and motor. When the limit switch is triggered in the direction that the carriage is traveling, the horizontal motor will stop, breaking the circuit. The switch however is bypassed by a diode which allows current to travel in only one direction. With the switch activated, the circuit is broken and current cannot pass through the diode. However, when the polarity of the voltage to the motor is reversed, therefore changing its direction, the current can pass through the diode and the motor is again powered. A limit switch is present at both ends of the tracking.

Be certain that the limit switches are not damaged or moved at any point. This could cause them to fail to properly stop the gear motor and cause the horizontal screw drive to pull the carriage past the end of the horizontal tracking. If necessary, the limit switches can be replaced by simply unscrewing them, disconnect the three spade clips, and substituting with an equivalent limit switch that is capable of supporting up to 5 amps at 12 volts DC. Also be careful not to damage or put excess stress on any of the wires or spade clips attached to the limit switches as this could damage the switch or even the circuit powering the motor.

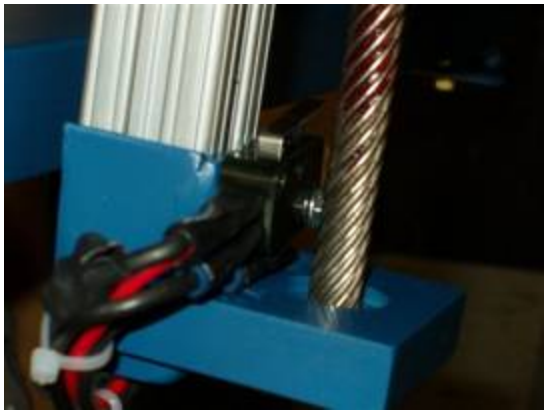

Figure 2.2.7

X. Joystick Plug Ports

A male serial port can be found on the joystick enclosure and a female port on the left side of the easel base. These ports are connected by a standard 9-pin serial cable. They do not require any maintenance other than being protected from damage. The ports, male

especially, contain a number of small pins that, if damaged, could severely affect the functions of the easel. These ports are not easily replaced, however it is unlikely that they should require replacement if taken care of.

Figure 2.2.8

XI. Joystick Serial Cable

A standard 9-pin serial cable connects the joystick to the easel. This cable has a set of threaded screws at both ends. When connecting the cable to the joystick enclosure, push the plug firmly into the port, and tighten the thumbscrews into the screwlocks on the side of the enclosure port. On the easel base simple push the plug firmly into the port. Be CAREFUL not to exert excessive force on the cable or any of the ports as they could be permanently damaged. The only replaceable component is the cord itself. It is a standard male-to-female serial cable that can be purchased from any electrical or computer supplier.

XII. Joystick

The joystick requires little maintenance other than being careful not to exert excessive force. Extreme force is not required to move the easel. Take care not to spill any liquids on the joystick or its enclosure. Should the joystick ever need to be replaced, a duplicate model can be obtained from P-Q Controls, Inc. of Bristol, CT. The model number for the joystick is M215-78SW-S-66. To remove the joystick unplug the connecting cable and unscrew the four screws holding the joystick enclosure together. Looking at the underside of the joystick TAKE CAREFUL NOTE of all wiring connections; these will all need to be disconnected. The four screws on the top of the enclosure must also be removed. This will release the joystick. Carefully pull the joystick out of the enclosure and reverse the procedure with the new joystick.

Figure 2.2.9

Section 3 – Technical Description

Section 3.1 – Mechanical Design

I. Left and Right Table Clamps

Constructed from 1/8-inch thick 1-inch square steel tubing and 1/8-inch thick 1x2 inch steel channel, these clamps are constructed to counteract the moment created by the floating base, canvas attachment, and canvas overhanging the table's edge. The steel channel extends back 12 inches to a nut welded to the end with a threaded steel rod passing through it. The ¾" steel rod includes a handle on the bottom and a rubber footing on the top to protect the table.

Figure 3.1.1

The 1-inch square tubing extends perpendicularly from the channel and is perforated with 5 holes running lengthwise to the top. The table clamp pins (Figure 3.1.2) are inserted through these holes (Figure 3.1.3) and a matching hole in the easel base extensions to allow for the clamps to be adjusted to a variety of table widths and configurations.

Figure 3.1.2

Figure 3.1.3

II. Easel Base

The easel base is the easel's main structural stabilizer. It is constructed out of ¼" thick 2 inch square tubing and is extremely strong and sturdy (Figure 3.1.4). Extending downward from the easel base are the easel base extensions (Figure 3.1.5). These easel base extensions receive the perforated square tubing and pin (Figure 3.1.6) and allow the clamps to be attached to the rest of the easel.

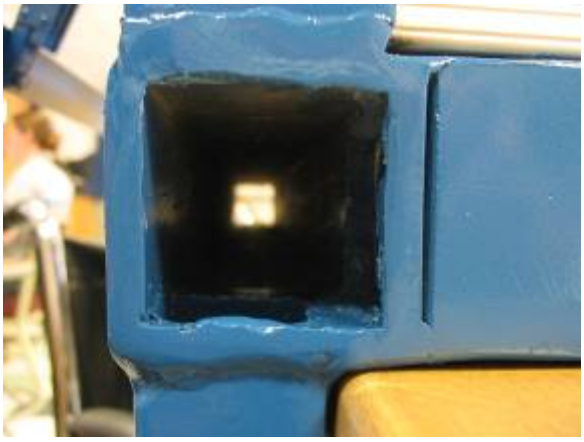

Figure 3.1.4

Figure 3.1.5

Figure 3.1.6

Attached to the top side of the easel base are two pieces of 80/20 10 series aluminum extrusion (Figure 3.1.7) that run from the front to the back. These pieces of extrusion are attached to the easel in the front via aluminum end caps that are welded down (Figure 3.1.8) and in the rear by a piece of angle and two self-tapping screws (Figure 3.1.9).

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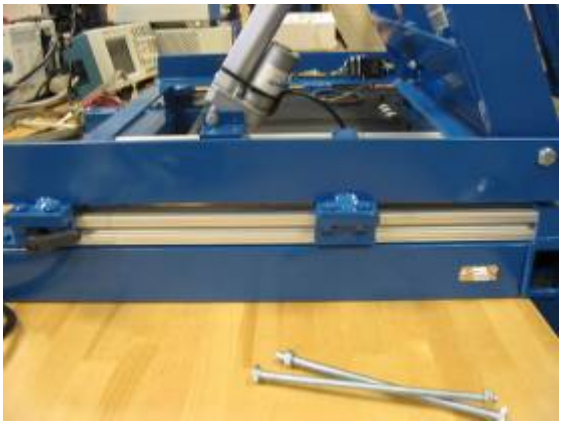

Figure 3.1.7

Figure 3.1.8

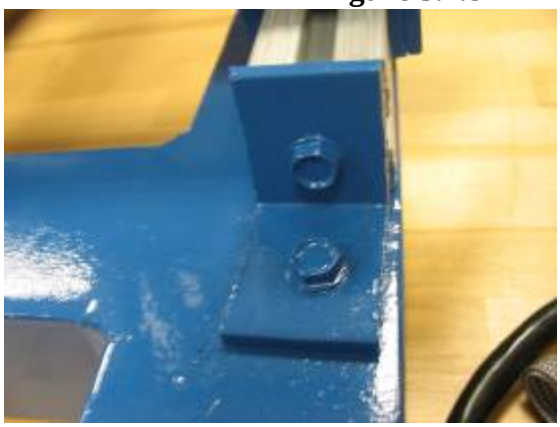

Figure 3.1.9

III. Floating Base

The floating base sits immediately atop the base of the easel and is connected by four 80/20 6725 10-Series Double Flange Linear Bearings (Figure 3.1.10) that ride in 80/20 10 Series aluminum extrusion. These four bearings allow for the easel to move in and out 6 inches while safely distributing the moment generated by the extension of the easel beyond the table (Figure 3.1.11). In the rear left corner of the floating base there is a special 6425 10-Series Double Flange Linear Bearing that allows for a locking handle that holds the floating base locked in place (Figure 3.1.12).

Figure 3.1.10

Figure 3.1.11

Figure 3.1.12

The majority of the floating base is constructed from 2 inch aluminum angle. As seen in Figure 3.1.11, there are holes drilled in front of the floating base through which the pivot pins will be inserted to allow for the tilting and attachment of the easel frame (Figure 3.1.13). Also attached to the underside of the floating base is a third piece of 80/20 extrusion (Figure 3.1.14) to which a 6715 10-Series Single Flange Linear Bearing which has been specially modified to accept a breaking mechanism is attached (Figure 3.1.15). One end of the tilt linear actuator is attached to this bearing. This bearing allows for the angle through which the easel rotates through to be adjustable between -35° from vertical (Figure 3.1.16) to +60° beyond vertical (Figure 3.1.17). In order to limit this range of motion, a piece of angle is welded to the extrusion to act as a stop (Figure 3.1.18).

Figure 3.1.13

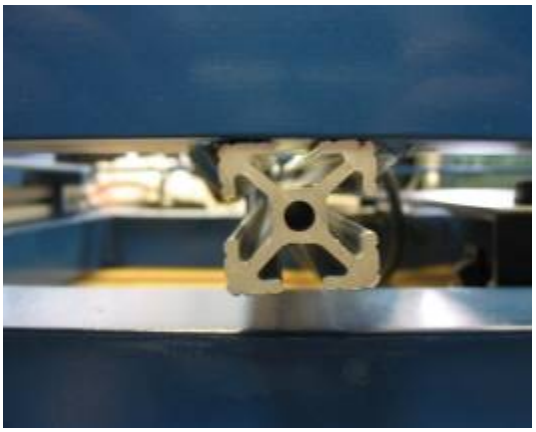

Figure 3.1.14

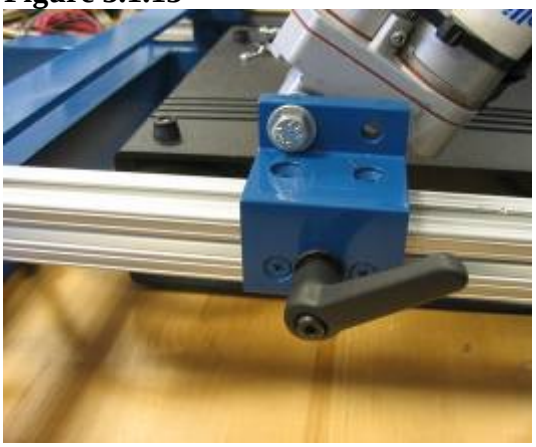

Figure 3.1.15

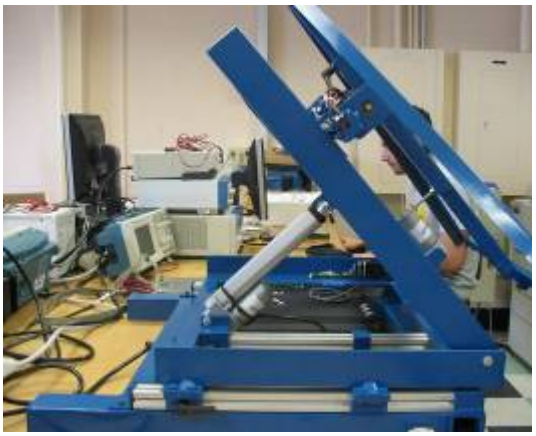

Figure 3.1.16

Figure 3.1.17

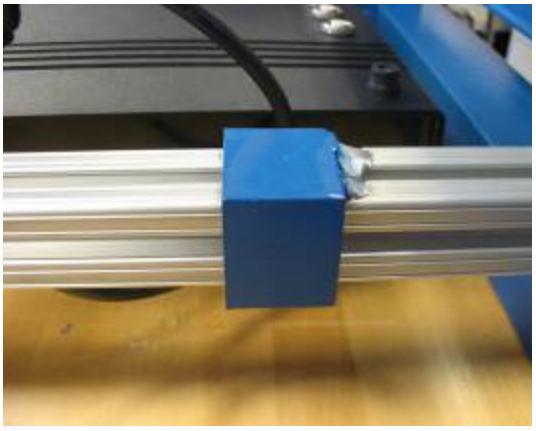

Figure 3.1.18

IV. Easel Frame

The easel frame is connected to floating base via the two easel frame pins (Figure 3.1.19) which allow it to pivot and tilt toward or away from the user. The right and left sides of the easel frame are constructed from 2x1 inch aluminum rectangular tubing to which two pieces of 2 inch aluminum angle are welded across the top and bottom. Running lengthwise down the middle of the frame is a piece of 1x2 inch aluminum channel. Running outward from the channel to the rectangular tubing are two pieces of ¾ inch square tubing. Lastly attached

to the square tubing and running vertically to the top piece of angle are two ½ inch aluminum rods. Running on the round rods are two pieces of ¾ inch square tubing and another piece of 2x1 inch aluminum channel that has two carriage bolts that hold down an additional piece of 1010 extrusion (Figure 3.1.20). Riding on the 80/20 extrusion is an 80/20 6726 10-Series Double Flange Linear Bearing. Bolted to the bearing is an aluminum plate and enclosure that houses a polyethylene bearing through which a threaded rod rides. Also bolted to the bearing is a mounting bracket for the easel face (Figure 3.1.21).

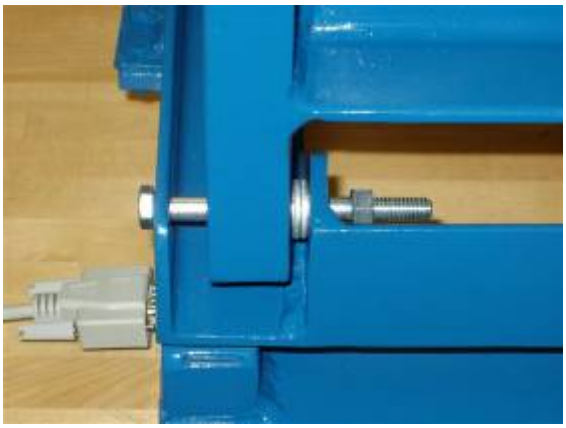

Figure 3.1.19

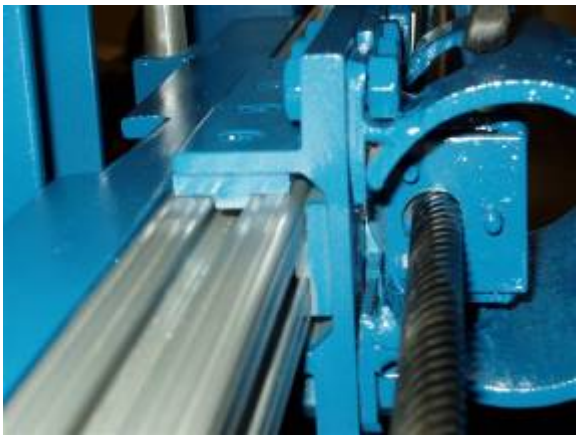

Figure 3.1.20

Figure 3.1.21

The threaded rod is held on to the aluminum extrusion via specially made brackets that contain pillow block ball bearings on the ends (Figure 3.1.22). On the right side of the easel frame, the motor and its enclosure are attached by means of the top of the enclosure being secured to the threaded rod's bracket using self-tapping screws (Figure 3.1.23). Long threaded rods are run through holes in the enclosure's top, through the motor (Figure 3.1.24), and out to the other end of the enclosure. The rod is secured by nuts as it passes through each of these components and at the other end of the enclosure (Figure 3.1.25).

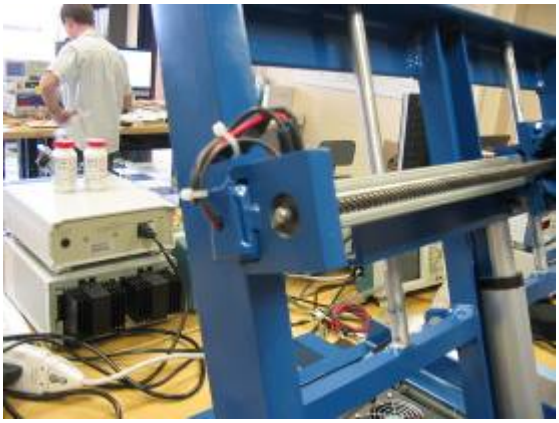

Figure 3.1.22

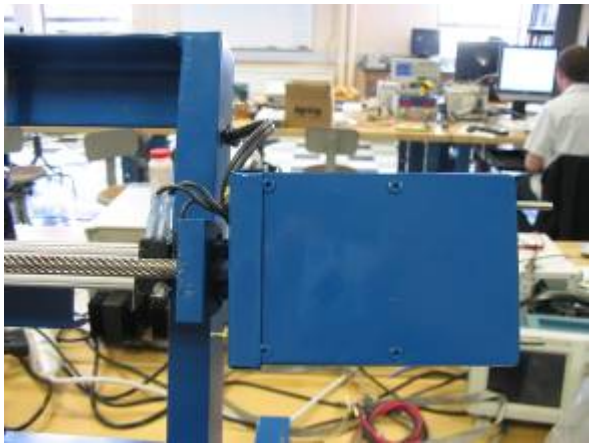

Figure 3.1.23

Figure 3.1.24

Figure 3.1.25

Located within the center channel is the vertical linear actuator. It is secured at the top to the screw drive assembly by means of a bolt and to the channel (Figure 3.1.26) at the bottom by a cotter pin. To take up the space between the cotter pin and the bottom of the channel, a spacer was added (Figure 3.1.27).

Figure 3.1.26

Figure 3.1.27

V. Easel Face

The easel face is constructed from two pieces of 80/20 1050 Series aluminum extrusion placed back to back (Figure 3.1.28). These two pieces are joined together using two aluminum brackets with 4 rivets for each (Figure 3.1.29). At the top of the easel face, the two pieces of 1/16 inch thick 2x1 inch aluminum angle are joined to the extrusion by two rivets (Figure 3.1.30). Running across the bottom of the face is another piece of 2x1 aluminum angle. The side pieces of angle are joined to the bottom by means of two counter-sunk bolts (Figure 3.1.31). Using another counter-sunk bolt, the bottom piece of angle is held to the extrusion (Figure 3.1.32), creating a triangular face.

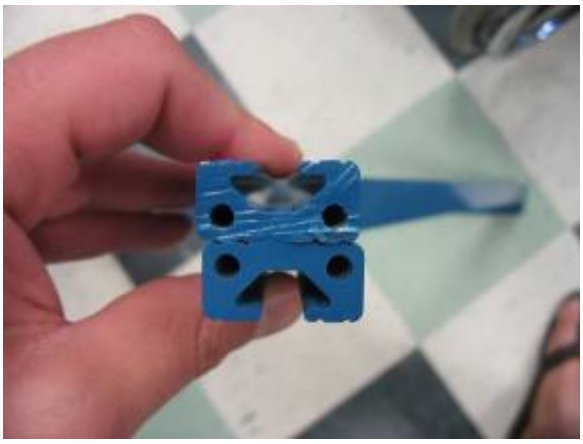

Figure 3.1.28

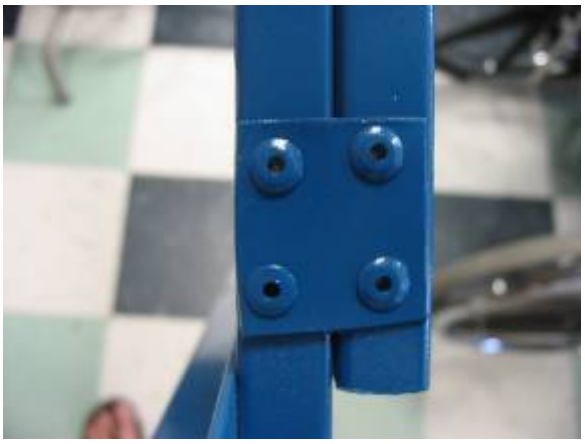

Figure 3.1.29

Figure 3.1.30

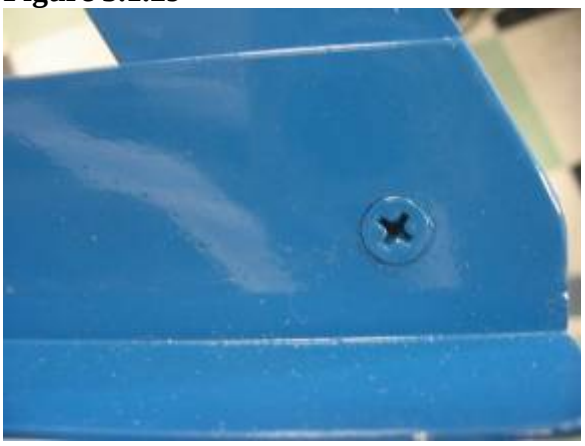

Figure 3.1.31

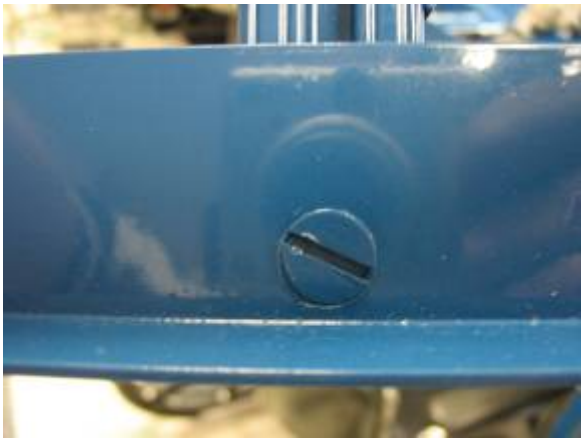

Figure 3.1.32

Section 3.2 – Electrical System

The electrical system controlling the easel is a vital component in the overall functioning of the system. While it requires little mechanical design, the mechanism controlling current flow throughout the system must be efficient, practical, and reliable as it powers the actuators which are perhaps the most important modules in the design.

The easel itself is powered by 120 volts AC which is supplied from a standard wall socket. Extending from the rear of the easel is a 14', 120 volt AC grounded electrical cord that provides power from a wall socket to the easel. This cord passes through the rear of the easel, is knotted to prevent it from being pulled back through the easel, and enters the electrical enclosure. There are three wires enclosed in the power cord. The black, powered (hot) leg, which feeds 120 volts AC from the wall socket, runs through a single-pole/single-throw switch which is installed in the side of the electrical enclosure and serves as a master on/off control for the easel. By turning the switch off, all current flow to the easel and its circuit is halted. The remaining two wires in the power cord, the neutral and ground legs, are attached directly to the 12 volt,150 watt power supply within the electrical enclosure.

Leaving the master switch, the powered leg is then brought to the "line" terminal on the power supply. When the switch it turned off, the DC power supply in the easel is also off. Once the switch is activated, the 12 volt DC power supply transforms the 120 volt alternating current (AC) to 12 volts direct current (DC) which is used to power the easel.

Movement of the easel is controlled by two separate linear actuators and a single gear motor. One actuator controls the vertical (up/down) motion of the easel while the second actuator controls the tilt feature. The gear motor is used to rotate the horizontal screw drive which ultimately causes the easel to travel left and right. The actuators used in the system run on 12 volts DC and at a full load will draw 3 amps. The gear motor also runs on 12 volts DC and draws roughly 2 amps at full load. Assuming that all three motors were operating simultaneously at full load, the total current draw should not exceed 8 amps. To ensure adequate power, a power supply providing a maximum of 12 amps was chosen.

The power supply outputs directly to three separate 2amp 12 volt DC circuit breakers – one for each motor/actuator. Therefore, the actuators and motor are limited to a maximum 2 amp current draw. This was done as a safety feature. If, at any point, the actuators or motor were operating at full load, it would indicate a significant problem with the easel. There are no operations for movement that actually require the full force of the motor or actuator. The breakers also serve as a method of short protection. In the event a wire became exposed and shorted on the easel frame itself, this would immediately cause a breaker to fault.

Six relays are used to control the current to the actuators. These relays are double pole double throw and rated for 15 amps at 12VDC (more than sufficient for their application). The feed terminals of each of the two poles for all six relays are connected to +12VDC and ground, respectively. The normally closed terminals were left unwired, and the normally open terminals are wired to the two legs of the actuators. Two relays were needed for each actuator; one to control extension and a second retraction (or clockwise/counterclockwise

rotation for the gear motor). This is because the direction of the actuator/motor is controlled by reversing the polarity of the voltage. Therefore each set of 2 relays will be wired oppositely. Both relays will receive the same inputs; however, their output terminals will be wired alternately. By design, only one of the relays for each motor/actuator can ever be activated at a time. Therefore by changing which relay is active, the voltage polarity can be alternated.

A single joystick is used to control the movement of the easel and consists of a 4 directional handle which activates 4 separate momentary micro switches – one switch for each direction. The left/right directions will control one pair of relays; the up/down directions a second. Additionally, a thumb rocker switch on the top of the handle provides for the remaining 2 relays. The joystick used is manufactured by P-Q Controls, Inc. of Bristol, CT (model number M215-28SW-S-66). Because the micro-switches are not capable of carrying the high 3 amp load of the actuators, each switch is connected to a +12 VDC supply. The output of each switch is wired to one end of the coil on one of the relays. The second end of the relay coils is connected in parallel to ground. As a result, when one of the joysticks is moved in a certain direction, the micro switch is activated. This allows the 12VDC to power the coil in a particular relay. The relay mechanism will then engage the contacts on its poles and allow the actuator to be powered.

The power entering the joystick (which is ultimately passed though the individual microswitches to their respective relays) is first run though an illuminated rocker switch. Turning this switch off does not allow any of the microswitches to be powered, and therefore does not allow the joystick to cause the easel to move. When turned on, the rocker switch will light, alerting the user that the joystick is active, the microswitches are able to transfer power to their relays, and the easel is able to move. This switch was requested by the client to ensure that the joystick cannot be accidentally moved when not desired.

Since the joystick requires 8 wires passed to it from the easel a 9-pin serial cable was used. Male and female connection ports were mounted to the side of both the easel and the joystick enclosure. Each relay requires a separate wire therefore accounting for six of the 8 wires. The final two wires were the 12 volt DC supply and a ground wire which allows the rocker switch to illuminate. A common 9-pin serial cable is used to connect the joystick to the easel.

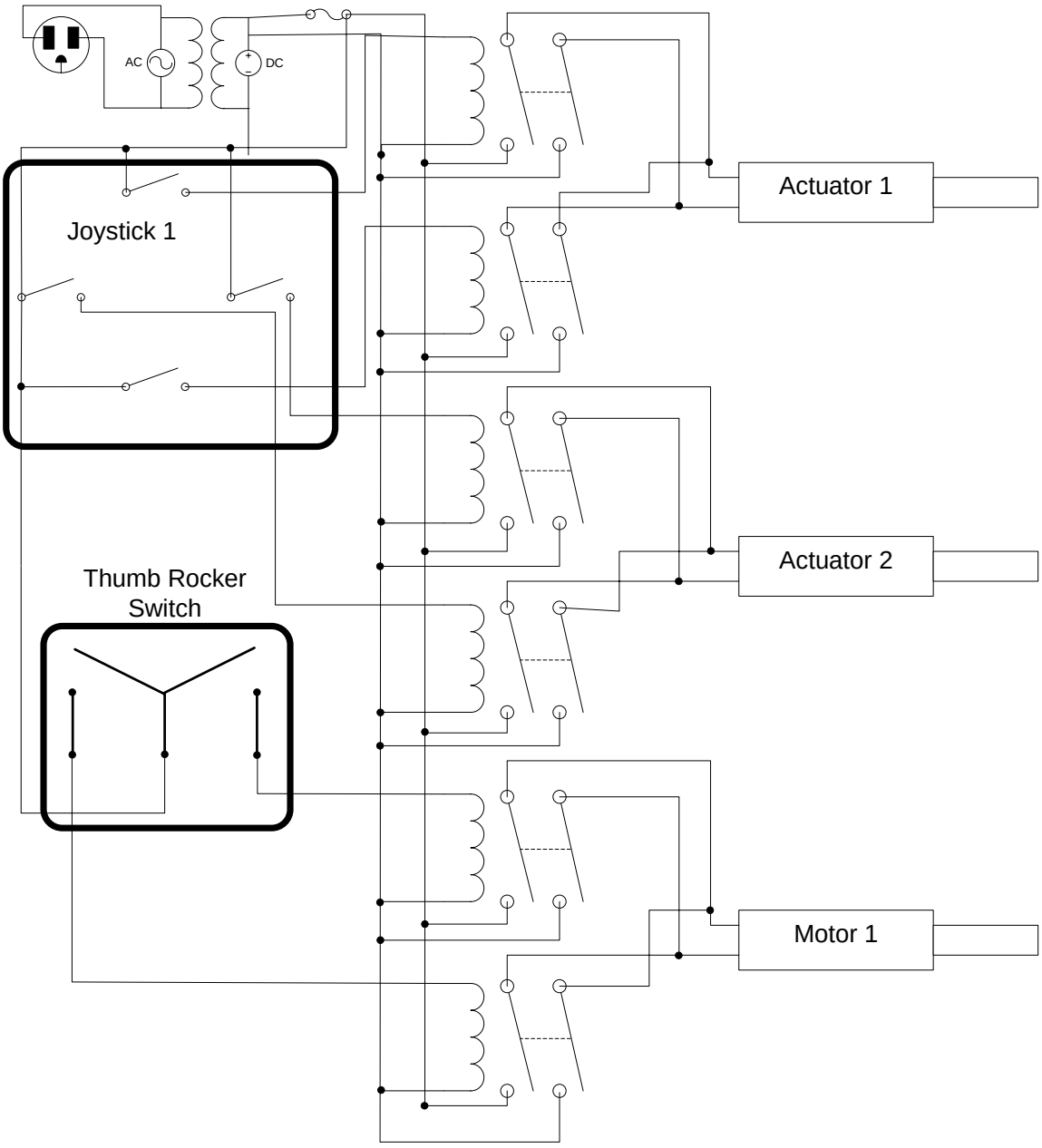

Figure 3.2.1: Wiring Diagram of Electrical System

Figure 3.2.2: Wiring of joystick

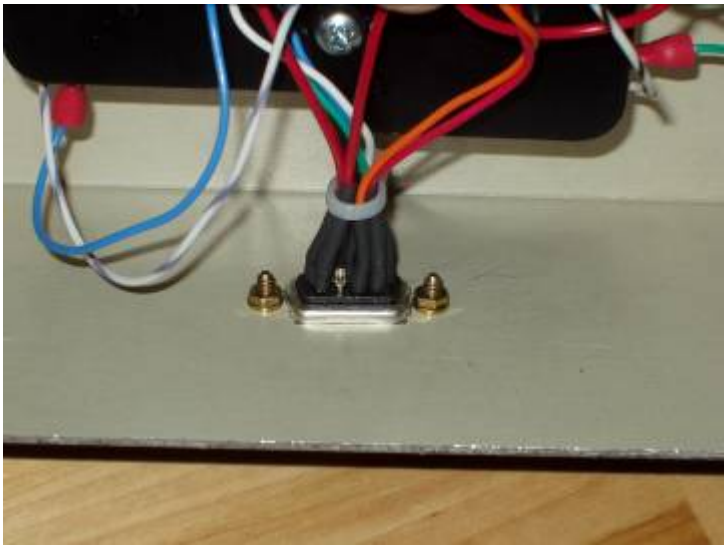

Figure 3.2.3: Wiring of Serial Port

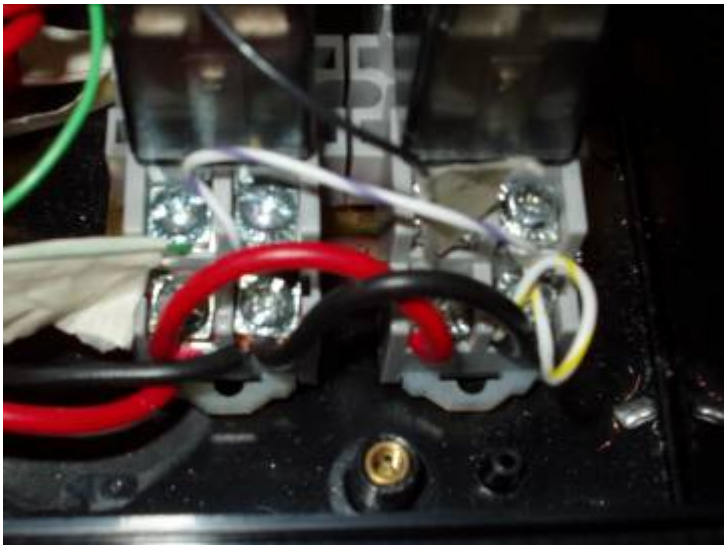

Figure 3.2.4: Relay Wiring

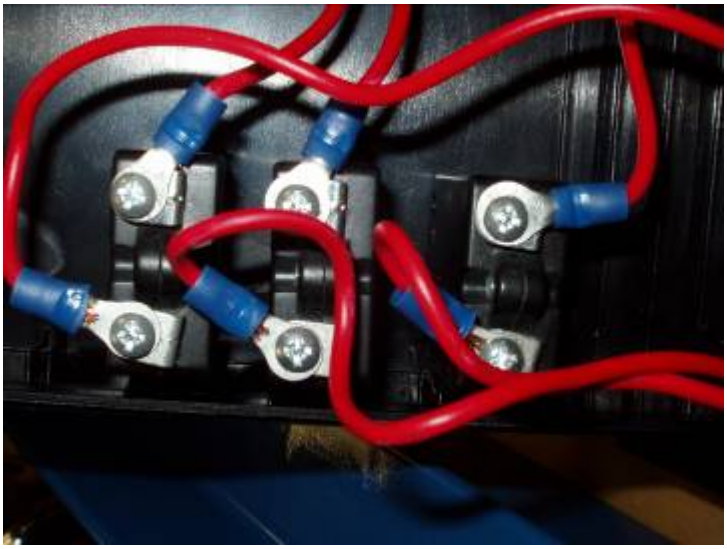

Figure 3.2.5: Wiring of Circuit Breakers

Figure 3.2.6: Wiring of Power Supply

Section 4 – Troubleshooting

Section 4.1 – Mechanical Troubleshooting

I. Left and Right Table Clamps

1. The clamp will not fit into the easel base extension.

   This is due to the fact that the easel base extensions are custom made for each clamp, and therefore there is a correct "right" and "left" clamp. A correctly installed clamp will have the "open" portion of the channel facing inward (Figure 4.1.1).

Figure 4.1.1

2. The table being used has a lip and the threaded rod of the clamp will not go low enough to fit over it.

   The table clamps are completely adjustable to fit any table configuration and have several different holes drilled in the square tubing portion (Figure 4.1.2). If the rubber feet of the table clamps will not fit under the lip of the table, simply remove the table clamp pin by undoing the wing nut on the end and pulling the pin out. Position the table clamp lower and then reinsert the pin and wing nut. Tighten the clamp up using the handle and turning the threaded rod clockwise.

Figure 4.1.2

3. I'm trying to turn the threaded rod and it will not turn at all.

   First, try spraying some penetrating lube, such as WD-40, into the nut. After a few minutes have passed, try turning the rod again.

Figure 4.1.2

4. The threaded rod will only turn so far and then it gets stuck.

   It is possible that there is debris in the threads. Try spraying the area where the nut becomes stuck with some WD-40 and then wiping it with a rag. Try to turn the rod again and see if it will pass through the affected area.

   If the rod still will not turn, or if there is visible thread damage, you can attempt to clean up the threads by running the rod back through an appropriate die if possible. If a tap and die set is not available or the damaged portion is inaccessible with a die, seek help from a local machine shop.

II. Easel Base/Floating Base

1. There's a lot of side-to-side movement.

   One of the linear bearings has worn down. Please add additional shims or replace the linear bearing according to Section 2.1.II in "Mechanical Maintenance."

2. When I try to slide the base out, it gets stuck.

   First make sure that the brake is loosened on the back left linear bearing (Figure 4.1.3). If it is loose, try grabbing the base towards the middle and pulling it out (Figure 4.1.4). If you try and pull the base out from one of the sides it's possible that you're creating a torque that jams the bearings.

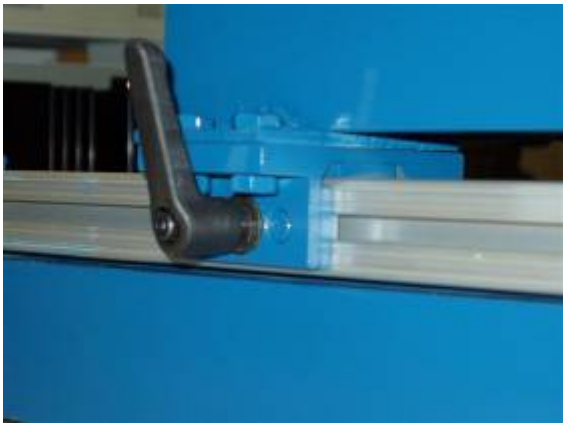

Figure 4.1.3

Figure 4.1.4

If the bearing still sticks, check the track to see if there is any debris obstructing the track. If there is, clean it out according to Section 2.1.II in "Mechanical Maintenance."

3. When I try to collapse the tilt linear actuator the top end contacts the base.

First, make sure that the tilt actuator is fully retracted (Figure 4.1.5). Next, make sure that the tilt adjustment slide is all the way back on its track (Figure 4.1.6). Also check to make sure that the spacer is correctly installed at the bottom of the tilt actuator and that it is not contacting the slide (Figure 4.1.7). If these conditions are met, the actuator should fully collapse downward (Figure 4.1.8).

Figure 4.1.5

Figure 4.1.6

Figure 4.1.7

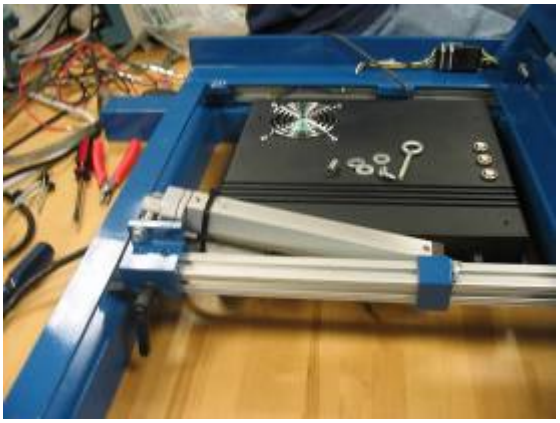

Figure 4.1.8

III. Easel Frame

1. The horizontal carriage gets stuck and will not move.

   Make sure that the screw drive is properly lubricated according to section 2.1.III of "Mechanical Maintenance." It is also possible that the carriage has not correctly contacted the limit switch at the end and has lodged itself. To free the carriage, simply move the joystick to the direction you with to move it in and apply a little force to the carriage in that direction as well (Figure 4.1.9). The applied force by the user should dislodge the bearing.

Figure 4.1.9

2. The vertical motion component gets stuck.

   Due do an improper loading of the easel face, it is possible that a torque could be put on the slide such that the square tubing lodges itself on the round bar rendering the vertical component unable to move. To dislodge the vertical component, first start by finding out which way it is torqued. If the right end is

lower than the left, apply a force such that the right end is rotated upwards while the left side is rotated downwards (Figure 4.1.10). Once the slide is straight, it should move without a problem. If the actuator still seems to struggle, apply a thin coat of bearing grease to the rods according to Section 2.1.III of "Mechanical Maintenance."

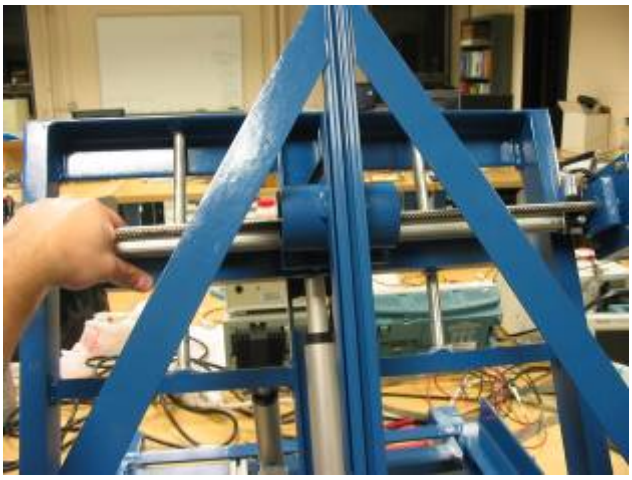

Figure 4.1.10

III. Easel Face

1. There is a lot of movement when I try to draw on the canvas.

   First make sure that the tilt linear bearing brake (Figure 4.1.6) and the linear bearing brake (Figure 4.1.3) on the floating base are securely locked in place. If they are both secure, check the polyethylene bearings on both horizontal motion components for wear and replace them according to section 2.1.II of "Mechanical Maintenance."

2. The bottom of the canvas comes in contact with the easel base extensions or clamps (Figures 4.1.11 and 4.1.12).

   To fix this situation, you must adjust the easel face to be higher on the easel face attachment. Start by loosening the L-brake handle on the back of the easel face attachment (Figure 4.1.13) with one hand and supporting the easel face with the other. Once the handle is loosened, slide the easel face up until it will no longer contact the easel.

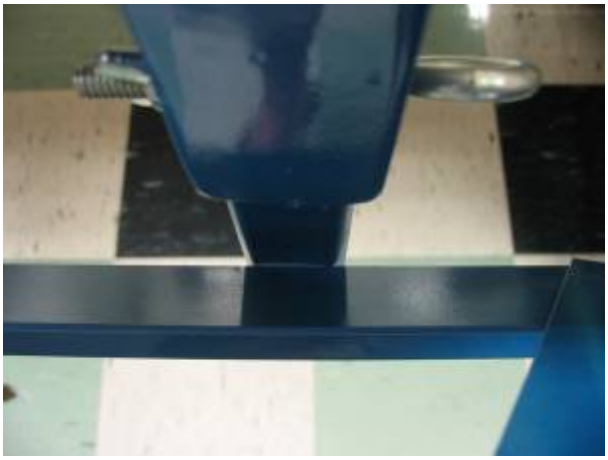

Figure 4.1.11

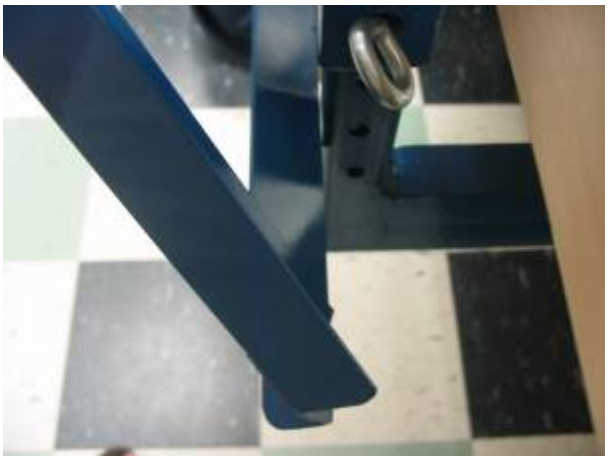

Figure 4.1.12

Figure 4.1.13

Section 4.2 – Electrical Troubleshooting

General Electrical Issues

1. I switched on the easel's power supply using the black switch. However, the fan doesn't even turn on.

   Make sure that the easel is plugged in to the wall or a power strip. If it is and the fan is still not turning on

2. The red switch won't light up and the joystick won't move the easel.

   First, check and make sure that the easel has been switched on and that the fan on the electrical enclosure is turning. If it is, next check the serial cable and make sure that it is firmly secured at the joystick and the easel base. If these conditions are met and the joystick still does not move the easel, seek professional assistance.

3. The light on the joystick turns on but the easel doesn't move.

   First check Section 4.1 for mechanical troubleshooting. If the issue is non-mechanical in nature, seek professional assistance because there is an issue with wiring or an electrical component.

4. Only some of the directions on the joystick work.

   Check and make sure that the serial cable is securely fastened at the base and joystick. Next move the joystick in a certain direction and listen for a relay click in the electrical box. If there is no relay click then check the circuit breakers on the top. If no circuit breaker is blown then a relay is dead or the wiring is damaged. Seek professional assistance or try replacing the affected relay on your own.